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ABSTRACT

Research findings on college instruction are discussed in 43 papers from the first Regional Conference on University Teaching. The papers are grouped under three large theme areas: "Teaching, Technology and the Future" (15 papers), "Computer Designed Instruction & Testing" (13 papers), and "Basic Skills: Dealing with Differences" (15 papers). The proceedings concludes with a special address by Donald C. Roush on "Quest for Quality." (AA)

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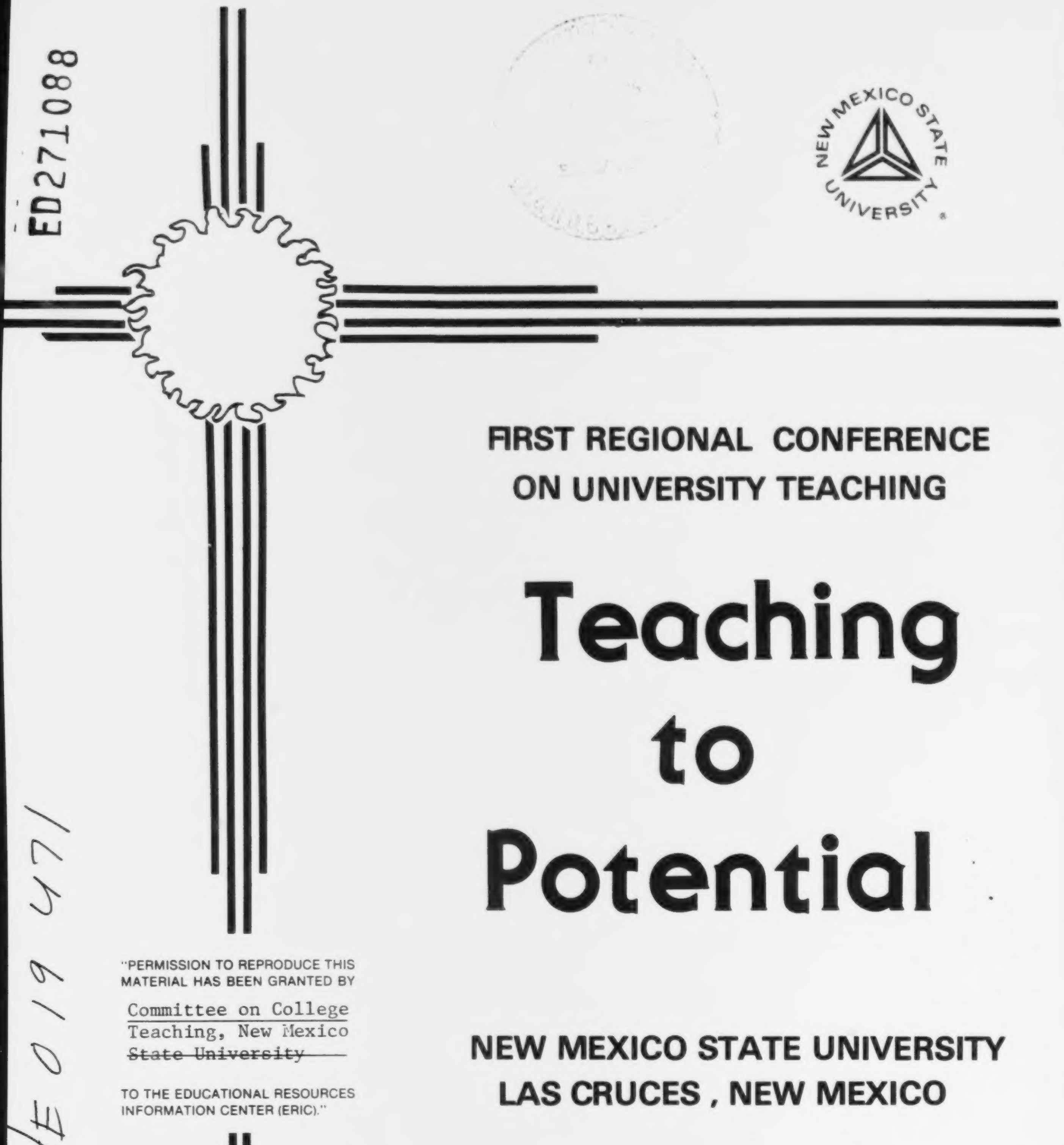

FIRST REGIONAL CONFERENCE ON UNIVERSITY TEACHING

Teaching to Potential

NEW MEXICO STATE UNIVERSITY
LAS CRUCES , NEW MEXICO

PROCEEDINGS
1985

HE 019 471

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This year, New Mexico State University sponsored the First Regional Conference on University Teaching. The purpose of this conference was to share, in a multi-disciplinary manner, research findings on teaching in higher education. The overall conference theme was 'Teaching to Potential' with three areas of presentation:

1. Teaching, Technology and the Future
2. Computer Designed Instruction and Testing
3. Basic Skills: Dealing with Deficiencies

I believe the Proceedings will be a helpful and stimulating source of information to those who are motivated to improve their teaching and to conduct further research in this area.

James E Halligan

J. E. Halligan
President
New Mexico State University

PROGRAM

First Regional Conference on University Teaching
New Mexico State University
Las Cruces, New Mexico

Wednesday/Thursday January 9 - 10, 1985
Corbett Center Ballrooms

Conference Theme: "Teaching to Potential"

Wednesday, January 9, 1985

8:45 a.m.	First Plenary Session Welcome: Dr. James Halligan, President New Mexico State University
9:00 a.m.	Thematic Address: "Teaching, Technology, and the Future" Presented by: Dr. William F. May Georgetown University
10:15 a.m.	General discussion & questions
10:30 a.m.-1:30 p.m.	Commercial Vendor Track & Faculty Displays
10:45 a.m.	Invited Papers and Discussion
1:30 p.m.	Second Plenary Session Thematic Address: "Computer Designed Instruction & Testing" Presented by: Dr. M. David Merrill University of Southern California
2:45 p.m.	General discussion & questions
3:00 p.m.-4:30 p.m.	Commercial Vendor Track & Faculty Displays
3:15 p.m.	Invited papers & discussion
4:30 p.m.	End of First Day

Thursday, January 10, 1985

8:45 a.m.	Third Plenary Session Thematic Address: "Basic Skills: Dealing With Deficiencies" Presented by: Dr. Suanne D. Roueche University of Texas at Austin
9:30 a.m.	Panel Response from New Mexico State University Panel Members: Dr. Gary Donart Ms. Betty Harris Dr. James Nordyke
10:00 a.m.	General discussion
10:15 a.m.-1:30 p.m.	Commercial Vendor Track & Faculty Displays
10:30 a.m.	Invited papers and discussion
1:30 p.m.	Donald C. Roush Awards for Teaching Excellence Introduction: Dr. Curtis Graham, Deans' Council Representative Presentation: Dr. James Halligan, President New Mexico State University
2:15 p.m.	Special Address: "The Quest for Quality" Dr. Donald C. Roush Executive Vice President New Mexico State University
3:30 p.m.	Reception for Recipients of Donald C. Roush Awards for Teaching Excellence Dona Ana Room - Corbett Center
4:15 p.m.	End of Conference

TECHNOLOGY, TEACHING, AND THE FUTURE

by

William F. May

Georgetown University

TECHNOLOGY, TEACHING, AND THE FUTURE

William F. May

March 1985

This essay on technology, teaching, and the future will cover both less and more than the announced title: less, because it will not discuss one-third of the advertised subject, that is, the future.

That omission will disappoint some. Our thirst for knowledge about the future knows few limits. Conferences abound on the subjects of "Business and the 80's," "Medical Ethics Ten Years Ahead," "The U.S.A. in the 21st Century." Our anxiety about the future is understandable enough. It goes back to the Greek general and his need to consult the entrails of birds on the eve of battle. Leadership means going--going ahead into the uncertain X of tomorrow. And that X stirs anxiety in decision-makers. Hence, the need for prophets and oracles, the modern equivalent for which is the consultant. In our day, consulting is a growth industry. Within the academy, social scientists have largely trained those experts who traffic in predictions. As opposed to humanists who deal with cultures in their singularity and who orient to great texts of the *past*, social scientists deal cross-culturally with human behavior in its generality and orient to the *future*.

But social scientists have recently turned more cautious about their capacity to discern the future. They used to talk about *prediction*, but they have down-shifted from predictions to *projections*, and more recently from projections to *scenarios*, and to multiple scenarios at that.

I tend to be cautiously agnostic about the future. As hard as we try to peer into the future (or buy books that cry shrilly of future shock) the future truly shocks because it is not transparent. For at least two reasons, the future confronts us as opaque.

First, the radical novelty of discovery and invention. While we can follow the track of discoveries and inventions already here or guess at the vector of others subject to incremental changes, or anticipate the widespread applications of still others, we cannot anticipate radical novelty, radical invention, because if we did, in a sense it would already be discovered, invented, already here.

Second, we can, in a sense, anticipate the impacts of technology on human beings, but, unless we are already convinced technological determinists and assume that human beings are wholly the victims of what they have wrought, we cannot predict what human beings will do with a given invention and application as it spreads throughout a culture. Thus freedom, as well as radical discovery, renders the future opaque.

That leaves me, then, with two-thirds of the title: technology and teaching. But I hope to broaden that title. I warned those who invited me to New Mexico State University that I was not competent to appear as an expert either on the computer or data base retrieval systems. They assured me that the university has its own in-house experts on that. Rather they wanted me to step back a bit and provide a philosophical overview on the general place of technology in the setting of an institution of higher learning, especially in its teaching enterprise. I accepted this assignment in the hopes of providing a general framework for which the real experts in subsequent sessions can provide more detail.

The business of a university is knowledge; technology links with knowledge at three points: its acquisition; its transmission; and its application. These three modalities of knowledge remind us of the threefold criteria by which universities judge their faculty members for tenure and promotion: research refers to the acquisition of knowledge;

teaching, to its transmission; and service, to its application. In assessing, however, live faculty members--those strange folk who talk and write for a living, fall in love, and worry about salary increases and retirement benefits--the emphasis falls on the first two criteria, research and teaching. In the assessment of technology, almost all the emphasis falls on service.

1. Technology and the application of knowledge. The emphasis on the value of knowledge as "service" shows up in almost all work on the subject of technology. Consider, for example, Daniel Bell's essay on "Technology, Nature and Society." He defines technology as "The effort to transform nature for utilitarian purposes."[1] He roots this power and effort in homo faber, man the maker, and cites the classical myth of Prometheus, who stole the fire of reason and creativity from the gods. But the Greeks chiefly celebrated the human capacity for reason not the capacities acquired through reason that might serve human purposes. The West had to wait for Giordano Bruno and Francis Bacon of the late sixteenth and early seventeenth centuries for its hymns of praise to a knowledge linked with dominion and power. Bruno wrote:

> The gods have given man intelligence and hands, and have made him in their image, endowing him with a capacity superior to other animals. This capacity consists not only in the power to work in accordance with nature and the usual course of things...but beyond that...to the end that by fashioning, or have the power to fashion, other natures, other courses, other orders by means of his intelligence, with that freedom without which his resemblance to the deity would not exist, he might in the end make himself god of the earth.[2]

Bacon, from this point forward (1583-5), felt that "a new order of events was at hand, the specific quality of which would consist no longer in a mere imitation of nature but in her domination by man."[3] Inasmuch as knowledge is power, the virtue of curiosity leads to virtuosity--the capacity to work great changes in nature--to produce magnalia naturae to match magnalia dei.

This godlike power, moreover, that flows from knowledge should redound to the benefit of humankind. Francis Bacon linked knowledge and power with universal benefit. This philanthropic outcome distinguishes scientists from mere magicians and alchemists. Wizards and magicians link knowledge with power, but they are tempted to think in proprietary terms about that powerful knowledge which they display. Bacon complained that they transform nature, but simply in order to arouse wonder and not to serve some larger human purpose. They are vain-glorious and self-seeking. They believe themselves to belong to a privileged class of illuminati, hermetically sealed off from the human race at large. The scientist, Bacon insisted, must add the virtue of philanthropy to those of curiosity and virtuosity. As Benjamin Farrington has observed, the new knowledge to be gained should be "...fed back into the industrial life of the nation. This was no small task, as Bacon well knew. It was King's business. It should not be left to the monk in the cloister, the alchemist's furnace, the rich nobleman's curiosity or the workshop of the artisan. It required to be taken under the wing of the government. For it was not simply an addition to knowledge but the inauguration of a new way of life, the great instauration of man's dominion over the universe."[4]

Bacon, take note, spoke of *man's* dominion over the universe, not of the dominion of *some* men over the universe, or of some men over other men, or of one generation over future generations. This universalist impulse distinguishes the scientist from the parochial magician, the wayside wizard, and the hermetical alchemist. The enlargement of powers reflected not the limited triumph of some, but the enhancement of the many. To this very day, we hold on to this sense of participation in knowledge and power. "One small step for man, a giant step for mankind." When we hear talk about the enlargement of human powers through science we are inclined to neglect the questions of whose power over what, at what price, and over whom, the question that especially haunts some today in the grand schemes for genetic engineering. We are inclined to gloss over these pointed questions and assume that the power acquired through knowledge eventually runs off into a kind of reservoir of power at the general disposition of the human race.

2. Technology and the acquisition of knowledge. Technology serves also the research enterprise. Here the emphasis falls not on utility and service but on knowledge as an end in itself. The myth of the holy grail, the quest for the intrinsic good replaces Bacon's Boy Scout myth of the great philanthropist.

I do not need to rehearse in this setting the role that technology has played in the acquisition of knowledge. The chairperson for every department in the sciences knows just how important technical equipment is to the research enterprise. It casts the most towering shadow across the budget. It affects the ability of the department to recruit its faculty members. Yet it is the *sine qua non* of a cathedral, research institution and almost every ambitious university campus has aspired to become such.

Nowhere has the importance of technology loomed larger in research than in the life sciences and there it has created problems for the notion of knowledge as an unconditional and intrinsic good. First, and most dramatically, the recombinant DNA debate posed questions about knowledge as an absolute good. Although that debate has largely resolved in favor of the advocates of such research--the dangers proved to be much less than first feared--the debate lifted a rock that exposed much to light.

When advocates for the research sold the enterprise to the community at large, they relied on the Baconian links between knowledge, power, and boon. They held out the prospects that the research would lead to a knowledge and perhaps control and cure of a variety of cancers and inherited diseases, such as diabetes and hemophilia, to the production of inexpensive new vaccines and plants that draw their nitrogen directly from the air rather than from costly fertilizers, and to a vastly improved knowledge of the genetics of all plants and animals and, eventually, humankind.

Other advocates of the research, however, appealed not to wondrous applications but rather to an unconditional right to know. The latter appeal raised the most interesting questions. It invoked the deepest of commitments to academic freedom. Critics of this second appeal noted that advocates of the research were, in fact, extending the doctrine of the right to know beyond its traditional limits. They were claiming not simply the right to know but the right to create unprecedented forms of life in order to attain that knowledge. Technology, in this case, is not simply an incidental by-product of the research but its indispensable pre-condition.

The special links between technology and the acquisition of knowledge in recombinant DNA research led to worries in the scientific community and in the public at large and to the development of federal guidelines. Some scientists, in turn, worried that such guidelines would constitute the wedge that would undercut the hitherto unconditional quest for knowledge. Today the geneticists, tomorrow, the linguists! The argument, however, based on the thin edge of the wedge, cuts only so deep. Federal regulations in this case would not justify a limitless intrusion on the right to know but regulate that right only as it requires the production of new forms, the deleterious consequences of which may possibly be great but cannot be fully assessed in advance.

As it turns out, those consequences have not been as serious as first feared. But some measure of caution made sense, at the outset, and scientists showed restraint at the Asilomar Conference. The fact of uncertainty attendant to the original research invited some wariness. It argued not for the green light of the technological triumphalists or the permanent red light of the alarmists but for an amber light. This caution itself may have some exemplary force as the society proceeds to the subsequent assessment of industrial applications. We cannot bemoan wanton and runaway applications if we have not laid carefully our moral foundations in the very acquisition of knowledge.

3. Technology and the transmission of knowledge. Broadly conceived, teaching includes not only the instruction of students but the teaching of colleagues. Writing for publication is part of the transmission of knowledge. Faculty members engage in teaching when they write articles, monographs, book reviews, and books. It is teaching without a classroom,

teaching to a wider audience of peers, who may or may not yet be engaged in a similar research enterprise. Thus, this essay on technology and teaching will have to consider the dual settings of students and colleagues.

The subject of technology, as it affects the transmission of knowledge, divides into two parts: the impacts of technology on the process of teaching and on the content of teaching. Impacts on the process of teaching further divide into impacts on the sciences and the humanities. I will emphasize the effects on the humanities because I am more competent to discuss the humanities and partly because impacts there may, in the long run, be more striking.

a. The Process of Teaching in the Sciences. The impact of recent technology on instruction and testing in the sciences is large, but, in two ways, conservative. First, it continues to strengthen the ancient apprenticeship system. Long before the advent of the computer, the enormous importance of equipment in scientific research and the need to cultivate in students research techniques had a conservative impact on instruction. The young learned by initiation into the research enterprise under the tutelage of senior scientists. They assimulated the activities of the research team. This apprenticeship system is a very old teaching tradition indeed, which the computer and other technological advances would not appear significantly to alter.

Second, instructors in the sciences will probably assimilate and utilize computer technology without disturbing the traditional characteristics of scientific instruction as sequential, incremental, and oriented to problem-solving. Further, the computer facilitates traditional modes of testing in the sciences. It handles superbly the grading of multiple choice and other types of examinations that allow for straightforward verification and falsification. In these aspects, the computer fits in with the sciences less disruptively than with traditional modes of instruction and testing in the humanities. With the exception of language study, knowledge and therefore course instruction in the humanities are only waywardly sequential. Further, the humanistic disciplines orient to problems which are hardy perennials rather than solubles, and they produce results more aptly displayed in interpretive essays, rather than in isolable true and false statements. On the face of it, the impact of the computer on scientific instruction and testing would disrupt traditional patterns less dramatically than in the humanities.

Although the computer would not seem to alter significantly patterns of student instruction in the sciences, it will change dramatically the mutual instruction that goes on amongst peers in scientific research. The computer permits scientists to contact one another and teach one another through "networking." This rapid computer access to the work of colleagues alters the meaning of publishing, the role of the library, and perhaps even the role of the local campus in peer instruction.

-Traditionally, scientists went public through publishing; thereby teaching others and exposing their work to peer criticism. But the speed with which exchanges can occur through computer networking may, at least in some settings and for some fields today, convert the formal act of publishing into a ritual of little more than archival/historical significance. The tedious lead-time required to place articles in journals today forces publications to lag even further behind the numerous exchanges and transmissions that occur through networking. The book becomes, at best, the tortoise in the transmission of scientific knowledge.

-Librarians have recognized these changes in the making and have begun to think of themselves as information centers rather than vaults for books. In some fields the data bank is crucial.

-Computer networking may also reduce the significance of the scholarly meeting as the forum in which scientists share their work in advance of publication. It provides cheaper and quicker access to colleagues than the jet plane.

-The computer also allows a research team--dependent as it is on mutual teaching among its members--to span institutions. Technology may reduce the significance of the campus as the local parish, as it were, in academic life, the place where exchanges of knowledge normally take place. Will it thereby lessen in turn the importance of a few cathedral institutions as the hosts for research? Will gifted faculty members at less prestigious institutions participate more easily in research projects? Will the phenomenon of networking help to democratize opportunities for faculty members, make them a little less dependent upon local investments in a big research library and all manner of lab equipment? These questions loom large, especially for younger faculty members who have entered the job market at a time of great over-supply and who have not secured posts at institutions commensurate with their abilities.

I have put these questions to consultants at the Carnegie Foundation working on these isssues, and they said, in effect, don't count on it.

Networking may in fact intensify exclusivity. It may produce some sharp distinctions between those who are "in the know," and those with only delayed access to information through more conventional outlets.

We may, therefore, need to face again the question of what it means to "go public" with research. Traditionally, the academician differed from the detective, the lawyer, the doctor, the FBI agent and the corporation research team, in that his research did not belong to a client--whether an individual, an institution, or the nation. Publicness is the essence of academic knowledge. It should enter into the commonwealth of learning. Knowledge exists to be taught, transmitted, and shared. Nationalism, in recent decades, has challenged this universalist impulse of the Academy. "For your eyes only" has replaced the earlier ideal of "for the eyes of anyone with the skill to read and to discern." Technology, in subtler ways than nationalism, may impose further limitations on the sharing of knowledge. Networking amongst a highly select circle of collaborators narrows the community with access to the latest research. We may need further reflection on the publicness of knowledge and the obligation of professionals to give access to that knowledge in diverse fora.

At the other extreme, the computer poses a challenge to the confidentiality of knowledge, especially knowledge whose original justification was its benefit to clients. Information about patients finds its way back into data banks which, in turn, provide access to users (such as insurance companies, employers, the government) who might exploit that knowledge for their own purposes adverse to the interests of the client. Thus the computer poses new questions for an old issue: the relative balance between the values of publicity, privacy, and secrecy in a democratic society.

b. Technology, the teaching process, and the humanities. The computer, of course, comes last in a long series of technologies that have affected the teaching process in the humanities. The written word, the printing press, and the television set precede it. Traditional societies depended upon the human capacity to remember what one heard. Oral traditions were inherently public (they required both a speaker and a hearer) and potentially disputatious (they allowed for give-and-take in the course of the transmission of knowledge). The written word, by contrast, emphasizes privacy (one usually reads alone) and encourages an assertive rather than a disputatious style (inasmuch as it is not open to direct contest). The invention of letters obviously extended human powers in that it enabled messages to span the obstacles of space and time. But, as Marshall McLuhan and Fr. Walter Ong, S.J., have emphasized, it also altered, and, in some ways, reduced human capacities. Plato observed in the Phaedrus that the Egyptian God, Toth, the inventor of letters, created forgetfulness by encouraging people to rely exclusively on the external written characters.

The printing press dramatically increased and extended the power of the written word. The increase in the number of scholarly journals alone illustrates the magnitude of this technological advance--from ten journals in 1750 to 100 in 1800, to perhaps a thousand in 1850, to an estimated 30,000 to 100,000 today.[5] This so-called knowledge explosion, of course, does not produce a pure gain. Since no one, not even the expert, can master all this available knowledge, the knowledge explosion has also generated an ignorance explosion. Since, moreover, knowledge creates power, ignorance correspondingly creates a sense of powerlessness. Even the expert is ignorant, and therefore powerless in much that affects his life. This state of affairs may help to explain the highly ambivalent feelings we harbor toward the knowledge-wielders in our culture--the doctors, the lawyers, the market experts, and the like. At once we need their expertise and yet we suspect them as they exercise power in the midst of our ignorance. Thus, changes in the process by which we acquire knowledge eventually produces a huge gap between the knowledge possessors and the society at large. A whole new class of professionals arise who become the dispensers of services from which patients, clients and the like benefit, but which at the same time renders them somewhat helpless and powerless.

The technology of television did not directly alter education as much as most people expected, at least not in the sense that television became a major aid and tool (or surrogate) for classroom teaching. But, in other ways, television has dramatically affected the teaching process. Children and young people spend more time before their television sets than in the classroom. For better or for worse, TV and allied media have largely supplanted the earlier teaching authorities of Western culture: first, the magisterium of the church; second, the apprenticeship system; and, more recently, the public school system. The ascendency of the new medium has affected the teaching function in at least three ways.

It has undermined the habit of patience which the medium of the written word requires--patience in acquiring skill in reading, patience in tracking after a line of thought that develops across the sentences and paragraphs of an essay, patience in acquiring the education that will yield as its reward a unilinear career, and patience, at length, in developing a career that requires hard work at the outset for the sake of a payoff at 45 or 50 years of age. Another name for this patience is deferred gratification. Not surprisingly, commentators dubbed the protest generation of the late 60s--nursed by the TV set--the Now generation. Students in the new culture period oriented with a vengeance to the present. They expected their information to come in twenty-second bites. Forty seconds seems an eternity on TV. One can, of course, convey some information within those constraints, and the artful TV host can signal an attitude with a glance--the mocking tone, the lifted eyebrow, or the glittering cynicism of a Johnny Carson. But a complex appraisal, or an intricate argument, looks hopelessly out of place within the constraints of TV. Thus, one tends to settle for information rather than knowledge, wisecracks rather than wisdom, a stance toward a subject rather than its painstaking interpretation.

Perhaps the tendency of TV to encourage a cynical attitude may be its most dangerous impact on education. Everyone feels some objective warrant for cynicism in the course of his or her education. It properly undercuts the tendency to glamourize, sentimentalize, or idolize the merely ordinary. But cynicism, when it fixes itself in the young, dangerously obstructs education. It destroys the capacity for discriminate appraisal. Everything gets trashed. The noble as well as the trivial reduces to the same rubble in the cynic's eye. At its worst, cynicism is an uneducable style. The habits of impatience and cynicism which TV reinforces daily do not easily convert into the discipline required in the classroom.

Further, TV affects the very *telos*, or aim and purpose, of teaching. In orienting the viewer to the present moment it emphasizes chiefly gratification. Students, by habit, justify schooling for its usefulness in enlarging opportunities for consumption, by providing them with a career and enlarging their capacity to savour those goods which a career places within reach. The medium reminds the watcher daily that, above all else, he is a consumer.

By delivering this Jeremiad I do not want to present myself as a Luddite, ready to smash any and all TV sets. In the moral life, Aristotle once noted that we should not expect to eliminate what we are but learn how to lean against our weaknesses. Similarly, we need not eliminate any and all of our prevailing technologies, but learn how to lean against their weaknesses.

While scholars in the humanities may not use the computer as much in teaching as their colleagues in the sciences, its use will surely increase, especially in highly sequential language instruction, and certainly surpass the use of TV as a teaching aid. We may expect several impacts similar to those already sketched in the discussion of the sciences. The library will broaden into an information center whose resources for sharing knowledge far transcend that of printed books and articles. The organization of information and retrieval systems allows for interactive team research that extends beyond the local campus (although humanists work less often in teams than their colleagues in the social and natural sciences). Computer-aided instruction will give the scholar and student in remote areas access to instructional resources thus overcoming some of the limitations of the bounded residential campus.

One wonders whether computer technology will diminish the role and authority of the individual teacher. Will computer technology put teachers out of business the way fluoride, dental sealants, and anti-bacterial agents have reduced the need for dentists? Martin Buber once defined the teacher as the one who experiences what the student is going through, whereas the student does not experience what the teacher is enduring. Computers seem to comply with this definition. They anticipate our questions and mistakes, they substitute algorithms for human judgment.

Each major technological development in communications appeared to threaten the place of the teacher. Oral cultures absolutely required teachers; learners needed to hear words directly vocalized by their mentors to have access to knowledge. The written word, however, allowed one to do without the living presence of the teacher by giving access to the absent instructor, the one whose voice one had never heard. Students could work with texts in solitude. The later invention of the printing press greatly extended the reach of knowledge without the mediation of living teachers. The computer goes still further. At least the printed word gives the reader the sense that she deals with an author--a human presence to be reckoned with. Even though absent or long since dead--the author exists as a teacher. The working computer with its silicon chips simultaneously resembles the human brain as no text on the printed page does; and yet, it never gives one the sense that one reckons with an author. The original programmer remains somewhat elusive--despite the little jokes and asides and contrived intimacies inserted into the program. The advances in technology from oral to digital transmission would appear to dispense increasingly with the teacher in the acquisition of knowledge.

Yet, the teaching profession did not disappear in the course of earlier technological innovations, and we have little reason to think that the computer will eclipse the teacher today. The printed page, to be sure, dispenses with the oral transmitter of sacred stories, but it generated a need for mediators and interpreters of established texts. The classroom also served as the generator of new texts. Teaching, if anything, became more creative. In an oral culture, teachers had to repeat what they had received. Repetition guaranteed the persistence of a tradition. The printed word allowed teachers to dispense with repetition. It left them free for the hermeneutical task of interpreting, evaluating, and applying texts to new settings and conditions. Thus the meaning of tradition itself changed. Tradition no longer entailed the umbilical receiving of stories from one's elders. One distanced oneself from a text as one received it through the acts of interpretation and re-interpretation. This more distanced form of traditioning provoked a new mode of oral discourse, not pupils reciting what they memorized, but learning to discuss a text. It thus cleared the way for the production of new texts; that is, the refurbishing of old traditions and the introduction of new ones.

In one sense, the impact of computer technology on instruction and testing in the humanities will remain limited. Except for introductory language instruction, the humanities disciplines do not easily lend themselves to sequential, unilinear, and incremental instruction. Further, true and false tests and multiple-choice examinations systematically falsify the meaning of the mastery of a subject in the humanities. Such mastery depends upon the organization of materials into intelligible wholes expressed in writing and speaking. But a very specific feature of computer technology--word processing software--should dramatically and favorably facilitate the development of that mastery.

Properly used, word-processing software will renew the importance of writing/editing in the humanities, the role of the teacher in that process, and perhaps help the student recover a sense of both the social and substantive purposes of writing.

Until recently, the sheer laboriousness of retyping papers reinforced other tendencies in American education that have discouraged students from editing and rewriting their examination papers. Teachers have merely served as judges of the final projects, giving them grades and offering a few marginal comments to justify in lawyerly fashion a given grade. Meanwhile, whatever students learned about English grammar tended to intimidate them as writers. They assumed that the rules of grammar served as rules of writing, telling them what not to do. Students must keep these stern rules in mind as they attempt to strike off error-free sentences; and since in their hearts they know that they cannot produce faultless prose, instruction in grammar tended to paralyze them as writers. Few sentences could run the gauntlet of the rules unscathed. Students thus solved their problem of writing by procrastinating until the last minute, then writing rapidly and desperately and turning in the unedited results. The ensuing grade merely confirmed what they already knew--their papers were not worth much (unless the teacher, desperate for students at a time of declining enrollments in the humanities, yielded abjectly to grade inflation and awarded cynically high grades for getting anything in at all.)

The computer will not, in and of itself, change all this, but word-processing software creates at least the objective possibility of reform. It eliminates the purely laborious side of rewriting, and therefore lets the teacher function as master editor, and encourages the student himself to learn something about editing as he rewrites his paper, both before and after turning it in. This reform, of course, will not occur unless a student learns that the rules of grammar serve primarily not as a means of writing well, but of editing well. The art of writing is rewriting, that is, editing one's prose. Such books as the Elements of Style serve not as a manual for striking off perfect sentences but rather as a help in identifying lame sentences and learning how to fix them.

This "fixing up" of one's prose, however, will trivialize if it seems no more than a way in which one learns how to dress up what one already knows. At its best, the discipline of writing an essay is a heuristic enterprise in which one does not merely package and disseminate what one already knows, but partly discovers it through the eyes of a stranger. As the saying goes, one learns through teaching. To the degree that the computer assists the student in becoming a better teacher through his writing, it strengthens the student as a student.

We will not, however, fully exploit these potentialities of the computer unless teachers accept it as part of their responsibility to develop students into good teachers whether they go into the teaching profession or not. Today, professors bemoan the fact that few of their students will enter the field of teaching. They flock for economic reasons to the non-academic professions. But that does not mean that they need not be good teachers of what they know in their writing and speaking. To do a good job in preventive medicine today a physician must be an effective teacher of her patient; to do a good job of counseling the client, the lawyer must effectively teach her client; to be effective in politics, a leader must effectively persuade his fellow citizens;

admittedly, business executives lead largely by command and obedience, but if they would cultivate the next generation of business leaders, they must learn how effectively to persuade their juniors and colleagues. The so-called non-academic professions need people with enhanced teaching prowess.

If teachers accept it as part of their professional responsibility to develop all their students as teachers, then they will need to revise the way in which they set assignments and examinations and conduct their seminars. When students write examinations today in the humanities (I leave aside multiple-choice and true or false exams in which teachers systematically suppress the impulse to teach), they adopt a kind of Morse Code. They invoke terms; they signal words rather than arrange thoughts in intelligible wholes. Their bad writing habits do not merely reflect laziness. The very social setting of the examination tends to encourage an unrevealing shorthand. After all, students write the examination for the teacher whom they (sometimes mistakenly) assume knows more about the subject than they do. They want merely to prove that they know the subject; they do not attempt to teach effectively and imaginatively what they know. It may make sense on examinations and papers to ask students to assume that an intelligent but ignorant friend has put the question, to help them break out of constricting jargon.

The loss of their traditional preferred constituencies of pre-professionals and professionals may help teachers themselves to teach and write better. They will need to learn how to reach out to a largely non-professional audience. The discipline of sharing with these new constituencies may affect favorably their own teaching and writing, and, perhaps, if the foregoing is correct, even their grasp of their subject.

As humanists learn how to open up their subjects for potential lawyers, doctors, and other strangers, they may acquire a fresh grasp of their sources and resources. At a minimum, increased attention will have to be paid to the quality of their own writing.

The computer will not, in and of itself, produce these substantive changes for students and teachers, but it places this exciting reform in education within our reach.

c. Technology and the Content of Teaching in the Humanities. It would be foolish to restrict discussion to the impact of technology on the process of teaching. One must acknowledge as well its impacts on the society at large which eventually affect the content of teaching. The successes of technology are many, but at the same time, it has created a whole range of problems that surface almost daily in our newspaper headlines, such as toxic waste, acid rain, nuclear arms, the rapid dissipation of both non-renewable and renewable resources, and the dozens of impossible quandaries that beset the medical profession today. In their first reaction to these weighty problems students retreat into a privatistic careerism. "I can't do anything about it. So screw it. I'll take care of myself." Alexander Astin of UCLA states that all indices across fifteen years show student interest in public issues declining. This withdrawal of students from public to private life has impoverished what might be called the civic self. This withdrawal coordinates further with the positivist dismissal of moral judgments to the realm of the private, emotive, and subjective, thus providing an intellectual justification for the neglect of shared values in our common life.

In the long run, however, this privatistic careerism may force us to rethink the content of teaching--better yet, the aim and intention of teaching. Oddly enough, it may lead eventually to the recovery of the classical mission of the liberal arts in the university curriculum. These ancient and honorable, but somewhat neglected, disciplines took it as their purpose: one, to cultivate critical intelligence, and two, to cultivate the civic self.

Since World War II, universities have tended to restrict their task to the training of technical rather than critical intelligence. Technical intelligence tells one how to get from here to there. Critical intelligence asks whether the there is worth getting to. It raises what has been incessantly called the question of ends or values. The modern positivist university has asserted that values are merely a matter of subjective preference and, therefore, do not qualify as a fit subject for critical study and judgment. (See Max Weber's classic essay on the issue, "Science As a Vocation.")

This positivist dismissal of values to the merely subjective prepared for a privatistic careerism in the student body. Since the university does not offer an area where reasoned discourse, debate, and discriminate judgments can be made on the subject of values without deteriorating into propaganda or advocacy, the information it offers is up for grabs to the highest bidder. Knowledge itself is a private property, not a public trust, to be sold entirely for private advantage. Who is to say otherwise? Certainly not professors who dismissed values as merely subjective. Thus the professional skills of students, finely honed in the descriptive disciplines, ended up for hire to further any and all private career aims.

We underestimate, however, the human intelligence if we assume that it can only give us information as to how to pursue ends but can raise no basic questions about the ends pursued, if it can bestow upon us techniques, but cannot subject to disciplined reflection and discourse the question of the ends which our techniques and technologies serve.

Second, our universities, if they would serve more than the privatistic career aims of our students, must help nurture the civic self. It must do so because modern technicians and professionals are, in effect, the new rulers in the west--they wield vast power in our society, a knowledge-based power. It is passing strange to have a ruling class without nurturing and cultivating a sense of civic responsibility in that class.

Ultimately, the nurturing of the civic self and the encouragement of critical inquiry belong to one and the same enterprise if value questions are not merely matters of private, subjective preference. To engage in critical inquiry is itself a social act that teases the mind out of the bottle of private preference and opens out toward a community of inquirers. We take our first stuttering moves toward citizenship when we can go beyond the bare ejaculations, "Well, I like this movie," or, "I don't like that play," and begin to offer intelligible explanations to our colleagues for our views. This kind of reasoned discourse tutors us in citizenship with one another. At its best, a liberal arts education is not a private transaction between the professor and her students. The classroom becomes a public place; the library, a commonwealth of learning; and critical inquiry among peers a kind of parliament of the human mind. Such critical inquiry is indispensable to technicians and professionals who have more than esoteric services to offer for private gain.

Will the computer itself assist us in addressing some of these problems, which technology and computer technology partly raise and with which the liberal arts must cope? Perhaps so--in one obvious, and in a second, relatively unexpected way.

First, one hopes that some problems generated by the mastery and control of the human environment will yield to yet further, more sophisticated technological interventions. The Romantics and Luddites among us scoff at this. They have reacted against technological triumphalism and grow skeptical, indeed cynical, about the optimistic assumption that technology has created no problem which it could not also solve. Still, one should not overlook ways in which technologists may learn from their mistakes. Computer studies of aerodynamics have helped design more fuel-efficient planes than their predecessors. The computer encourages letting form follow function instead of imitating old, pre-established, but inefficient forms. Older industrial technologies will give way to the less invasive and abusive subtleties of high-tech.

But computers may assist us also in a less expected way. Computers do not function simply as extensions of the human power to control nature, they also evoke in their users what Sherry Turkle of M.I.T. has called metaphysical questions and questions of one's own psychological identity. If Dr. Turkle is right, the computer may influence reflection in the humanities on some of the more enduring issues these disciplines face.

Turkle has observed that young users of the computer--six to eight years of age--are given at first to a kind of metaphysical animism. They impute human intelligence to the machine. This imputation provokes, in turn, thought about the distinction between human beings and the machine. The very resemblance of the computer to human intelligence provokes fundamental thought amongst young and old on the distinctively human. Interpretations differ.

Joseph Weizenbaum, fearful of the growth of instrumental reason in our culture--linear, logical and rule-governed thought--identifies the distinctively human with the ineffable, the uncodable, the uncapturable in language or formalist reasoning. John Searle argues that the computer follows rules which it does not itself understand. Human intelligence differs from purely operational, computational and manipulative intelligence by virtue of its capacities for self-reflection and self-understanding. Turkle, drawing on her studies of young children and their use of computers, locates the difference elsewhere. The machine doesn't have a mother; the machine doesn't suffer the experience of loss. Turkle writes:

> . . . we are born, we are nurtured by parents, we grow, we develop sexually, we become parents in our turn, we die. . . .A being that is not born of a mother, that does not feel the vulnerability of childhood, a being that does not know sexuality or anticipate death, this being is alien. We may be machines, but it is our mortality that impels us to search for transcendence--in religion, history, art, the relationships in which we hope to live on.[6]

I would add a further distinction between human reason and the computer--the human capacity to strike off a metaphor or simile; that is, to juxtapose two ordinarily dissimilar entities and to see them both better by virtue of that juxtaposition. This capacity to strike off metaphors lies at the root of our power to tell stories, and to traffic in images and symbols that shape our personal and collective lives. It would be foolish to argue that interaction with the computer for the first time uncovers the aforementioned distinctions between human beings and the machine. But widespread interaction may provoke the culture at large and the educational system in particular to think more deeply and afresh about these distinctions, and, to the degree that it does so, it may uncover and recover some of the intellectual resources which our culture requires as it faces the problems posed by abrasive technological change.

If Turkle can be credited, interaction with the computer not only augments mastery and provokes metaphysical questioning, it also provokes in adolescents (but also in others) a quest for personal self-interpretation, recognition, and identity.

At first glance this interaction would seem to lead in the opposite direction--to an escape from oneself and from others. Does not the computer already tempt young people only too bereft of social skills to avoid others? Will it not produce a generation of asocial computer hacks? Does it not encourage a narcissism, a withdrawal into oneself, accompanied only by the machine, precisely at that time in life when the student acutely needs to develop the social self or the civic self? Turkle's study suggests, however, a somewhat different outcome. The Narcissus myth need not lead inevitably to asocial, solepsistic withdrawal.

> There is another way to read the story. Narcissus fell in love with what appeared to him to be another. This image of that other person fascinated him because it objectified a sense of beauty of which he had felt only a vague inner

> sense. . .When you program a computer, there's a little piece of your mind, and now it's a little piece of the computer's mind, and now you can see it.[7]

This seeing of oneself at a little distance, in perspective, as it were, allows for a bit of self-interpretation, discovery of identity, and, in some touching cases, provides a clue to a new identity.

The computer itself provides metaphors for self-interpretation, in some cases optimistic, in other cases, pessimistic. Optimistic metaphors, such as "reprogramming" or, "getting the bugs out of the system," may, of course, deceive. They suggest that "painful emotional states--depression, inability to act, anxiety--are the result of purely local bugs,"[8] and thus they mislead about deep-going structures and syndromes. At the same time, the metaphor of the computer "loop" may deceive in the direction of pessimism; that is, the fear that the self is a "vicious programming circle where all paths lead back to the same unproductive starting point."[9]

In any event, let no one be deceived about the computer itself. It may not be able to produce a metaphor, but it fairly bristles with them in interaction with its human users. "Whether or not computer scientists ever create an artificial intelligence that can think like a person, computers change the way people think--especially about themselves."[10] Therein may be their last and finest contribution to the content of humanistic thinking and teaching.

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Footnotes

1. Daniel Bell, The Winding Passage, (New York: Basic Books, Harper, 1980) p. 7.

2. Benjamin Farrington, The Philosophy of Francis Bacon, (Liverpool: Liverpool University Press, 1964).

3. *Ibid*., p. 28.

4. *Ibid*.

5. *Op.Cit*., pp. 53-54.

6. Sherry Turkle, The Second Self; Computers and the Human Spirit, (New York: Simon and Schuster, 1984), p. 311.

7. *Ibid*., p. 155.

8. *Ibid*., p. 160.

9. *Ibid*., p. 161.

10. *Ibid*., p. 162.

BIOGRAPHY - WILLIAM F. MAY

Washington, D. C. -- William F. May joined the Kennedy Institute of Ethics, Georgetown University, in the Fall of 1980. He is the Joseph P. Kennedy, Sr., Professor of Christian Ethics there. A 1948 graduate of Princeton University, he received his B.D. *magna cum laude* (1952) and Ph.D. (1962) degrees from Yale University.

Before coming to the Kennedy Institute, Professor May served as the founding chairman of the Department of Religious Studies at Indiana University, and as chairman of the Religion Department at Smith College, Northampton, Massachusetts.

May is former president of the American Academy of Religion and is a Founding Fellow of the Hastings Center, where he co-chaired its research group on death and dying.

May has published essays on religion, politics and biomedical ethics. In addition to contributing chapters to a dozen volumes, he is the author of *A Catalogue of Sins* (Holt, Rinehart and Winston) and a monograph on *Professional Ethics: Setting, Teacher and Terrain* published as part of the *Hastings Center project on the teaching of ethics* in America.

The Indiana University Class of 1970 voted May a Distinguished Teaching Award. He has received post-doctoral fellowships from the Danforth Foundation and the Lilly Endowment, Inc. A Lilly Faculty Open Fellowship in 1976-77 permitted him to spend the year as an observer at the New York Hospital, where he became acquainted with the delivery of health care in a variety of institutional settings. He has taught summer seminars for physicians and other medical practitioners, under the sponsorship of the National Endowment for the Humanities, 1974-79, and seminars on management ethics, sponsored by the Yale School of Management, the University of Southern California and the Society for Values in Higher Education.

Wesleyan University invited him to be a fellow at its center for the Humanities (1974-75) on the subjects of "Art and Criminality" and "Terrorism as Strategy and Ecstasy." As a Poynter Fellow at Indiana University (1978-79), he wrote on "The Humanities and the Civic Self." Recently he served as an author and consultant to a National Science Foundation project on the "Ethics of Field Research in Anthropology and Sociology."

Dr. May received a Guggenheim Fellowship (1978-79) to work on the public obligation of the professional. Westminster Press recently published his book, *The Physician's Covenant; Images of the Healer in Medical Ethics*, November 1983.

BAUHAUS EXPERIENCE:
A TEAM METHOD OF TEACHING TECHNOLOGY

by

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and

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Northern Arizona University

BAUHAUS EXPERIENCE: A Team Method of Teaching Technology

Eugene W. Balzer, Ph.D.
and
Patsy B. Reed, Ph.D.

In a recent television commercial, the Xerox Corporation projects the thought that their office system computers are better than other computers because of teamwork. Their name, Team Xerox, suggests a notable value to be attained from teamwork in this age of specialization.

Many aspects of modern technology are individual or personal activities rather than team efforts. Note the name of small computers, "Personal Computers."

At a recent tour of a computer chip manufacturing company I observed what I consider a serious industrial problem of today and if not changed a problem of the future. That problem is related to the hierarchy of jobs and various degrees of team work or lack of within the hierarchy. The employees at the assembly or inspection line level were assigned individual tasks to perform and were not considered a team, although there were 10-12 people working under a supervisor who was in charge of their total production. If one person were sick it was up to the supervisor to find a replacement. How easy it would have been to organize these workers into a team. The team could have helped in most decision making processes. As an example they could have determined how to creatively solve problems of training new workers, scheduling of vacations and etc. In other words they would be in control of themselves rather than be controlled by others.

Ironically the supervisors were involved in an education program that dealt in part with teamwork and the teamwork process at the supervisory level. As companies turn more toward industrial robots and robotics it becomes crucial that all employees become a functioning part of the team.

Universities are partly responsible for producing highly specialized graduates with limited experience in working as a team. A quick glance in any Community College, our University catalog will reveal specialty areas within each college. What are we asking students to do? We are asking them to do individual papers, or projects. We then evaluate the individual paper, project or test. When the student finishes his/her degree we as professors are asked to fill out the standard recommendation form. A very important question on the form is "How well does he or she work with peers and associates?" We don't know because most of what we have asked them to do has been individual projects. The appropriate question is, "How do we teach the teamwork process to students in highly specialized fields of higher education.

The College of Design and Technology at Northern Arizona University, Flagstaff, Arizona is implementing, this spring semester 1985, a teamwork concept we are calling the Bauhaus Experience. The Bauhaus Experience is a historical concept that unifies function and design, and technology by establishing a group of talented artisans and technical experts to solve problems concerning all aspects of production. Architects Walter Gropius and Peter Behrens first expressed the concept in 1910 in Germany with their proposal for the "Industrial Prefabrication of Houses on a Unified Artistic Basis" in which they noted that solving problems on a unified artistic basis was a new move toward the syntheses of technology and art. By 1919 their concept had grown into the Bauhaus at Weimar in which Gropius coordinated the team effort of archigects, artists, craftsmen and technicians to design, produce, and market a wide variety of products including furnitre, textiles, dishes, and lamps. During the next two decades, the Bauhaus moved to Dessau and them Berlin, but was disbanded for political reasons in pre-World War II Nazi Germany. The Bauhaus concept of team cooperation and design has survived, and we to, hope to utilize the concept through which our students will work cooperatively to develop aesthetically pleasing high technology products.

A knowledge of the organization of our College is fundamental to understanding our ability to place this concept into operation. Our existing undergraduate programs are Interior Design, Construction Technology, Manufacturing Technology, Photography and Printing Technology, Fashion Merchandising, Dietetics, Foods and Nutrition in Business, Home Economics Education and Industrial Arts Education. In analyzing our College, we found that we have a diversified faculty and student body in all of our programs who were engrossed in their own individual activities.

By using product development as our prime motivator, we are involving students and faculty from all of these programs in the Bauhaus Experience. This experience in its infancy is scheduled as an honors program, but later may be required of all students in our college. The philosophy for the Bauhaus Experience was stated as follows.

The College of Design and Technology at Northern Arizona University respects the unity of human needs, aesthetics and technological expertise as requisite to successful product development and is committed to collaborative efforts of faculty and students in the spirit of the Bauhaus. We regard a strong foundation of fundamental and technological knowledge as an indispensible base on which we can build a cooperative problem-solving charge with the goal of product development and related studies. To this end, we see a productive union with industry, business, government and education as essential, and we value intra- and interdisciplinary cooperation as paramount determinants of the effectiveness of unified endeavors.

Ideas for the products to be developed in this first Bauhaus Experience class have come from both students and faculty. It seems that just as the saying goes that everyone has at least one book in them to be written, people in all fields seem to have ideas on products to be developed and produced. Possible ideas are improved infant cribs to prevent accidental deaths due to mechanical or design problems, improved clean burning catalytic wood burning stoves, quartz halogen lighting systems such as desk and floor lamps, electronic signal systems worn by toddlers and mothers that would alert the mother if the child fell into a swimming pool, safety devices for industrial machines, modular hours construction as a replacement for mobile homes, and functional limited space dormitory furniture for college students.

All product ideas will be reviewed by a council to see if they meet the spirit of the previously stated philosophy. For a short term success product the limited space dormitory furniture holds excellent promise. This idea is a spin-off from furniture built by enterprising dormitory students. Each Fall semester students are seen constructing crude 2x4, and 2x6 sleeping lofts. The space gained by elevating their beds is then used as a study area. In a brain storming idea session it became apparent that this basic idea could evolve into complete sets of dormatory furniture. This would include beds, desks, chairs and wall storage units.

The phases of product develoment by the faculty and student team in the Bauhaus Experience regardless of the product are:

1. research and development; 2. design; 3. production; 4. merchandising; and 5. consumer studies.

COLLEGE
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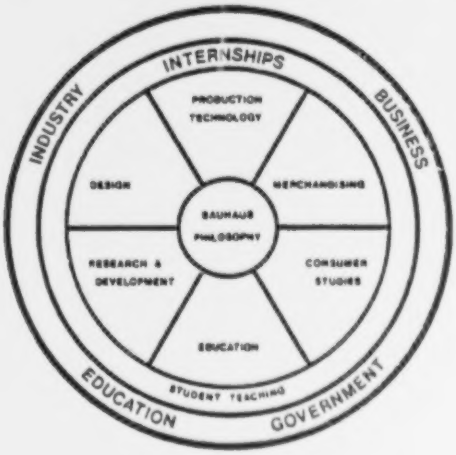
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CONSUMER STUDIES
EDUCATION
STUDENT TEACHING
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GOVERNMENT

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Allow me to talk you through the steps involved in this method of teaching technology. A long term project that would involve many of our faculty and students from most of our programs is the modular house construction as a replacement for mobile homes.

Research and Development: In the research and development phase, students, and faculty who may have release time from teaching would investigate the need for modular housing. In a preliminary investigation it has been shown that there is a definite need for durable low cost housing on the Navajo Indian Reservation. The ordinary box house provided by the government as low cost housing is aesthetically and socially not the most desirable Navajo housing. This research and development phase would also examine types of materials, feasability of materials for mass production, and the possible shape of the modular homes.

In talking with several faculty members the interest and willingness to cooperate on the modular housing project became apparent. Concrete as a building material was suggested and to aid in mass production the technique proposed was to make the concrete walls and forms an integral part of the finished home. In addition to the conversation about the concrete materials, another faculty member demonstrated interest in attending a construction convention. One of the main topics was concrete house construction.

By utilizing modular units for the walls, the finished house can take on many various sizes and shapes. An idea for the Navajo housing is to make the units into an octagon shape similar to their existing hogans.

Design: In the design phase both visual and mechanical factors are analyzed. The visual aesthetics of the design are blended together with the production factors. This is a critical point in the experience. It is the point where aesthetics and function meet. An evaluation factor is the construction of scale models and prototypes.

Production: The production phase involves the development of jigs and fixtures for the actual limited production. Line production problems are solved by simulated computer programs and producing several prototype modular houses.

Merchandising: Merchandising involves the use of computer programs to determine the actual cost of producing the product, and the margin of profit and financial forcasting. In addition, a complete advertising campaign and methods of financing is initiated.

Consumer Studies: The consumer studies phase is a final evaluation of the product. It is when our college and outside people determine the value of the product. It is our hope that our products will be of such high technical and visual quality that industry, business, and government will be interested in purchasing the rights to the developed product.

Beyond the product we hope that the journey through the teamwork process has been a most desirable experience for our students, our college, and industries.

From the various activities involved in the Bauhaus Experience of product development, it can be seen that to have a completed product requires teamwork. Faculty and students will be drawn upon to lend their expertise in the various phases of the product development. Both will be involved in a creative, innovative, interdisciplinary method of teaching and learning. Like the Xerox Corporation thinking that their compurters are better because of teamwork, we feel that our students and faculty will benefit form the cooperative efforts of our Bauhaus Experience in product development.

BIBLIOGRAPHY

1. Bayer, H., W. Gropius, and I. Gropius, eds., Bauhaus
Charles T. Branford, 1952

2. Koberg, Don. The Universal Traveler William Kaufmann, Inc. 1973.

3. Phillips, Gerald M. Communicating in Organizations,
Macmillan Publishing Co., Inc. 1982

ADVANCE ORGANIZER: AN EFFECTIVE PRE-INSTRUCTIONAL STRATEGY

by

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ADVANCE ORGANIZER: AN EFFECTIVE PRE-INSTRUCTIONAL STRATEGY

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Abstract: This study examined the effectiveness of an advance organizer in teaching science with a film to college students and the interaction of an advance organizer and the ability levels of the subjects. The results indicated that the advance organizer increased factual learning and retention from a sound film when it was presented in advance of the film showing. However, no interaction between the advance organizer and the ability levels was found.

Teaching facts and concepts with instructional films is a widely accepted practice in the classroom. Teachers use films to supplement or enrich related learning materials. However, a host of factors including the sequencing and arrangement of subject matter, previous knowledge of subject matter and intelligence appear to determine what and how much a student will learn from a film. Therefore, a variety of strategies has been suggested to prepare the students for new situations and knowledge. These strategies included inserted questions (Kantor, 1960), film clips (Baldwin, 1968), introductions (Arwady, 1978), and summaries (Lathrop, & Norford, 1953). All of these techniques work with varying degree of success when the instructor has previewed the film in question. These procedures are not always possible with the present-day demands on the instructor and the requirements of film distribution.

There have been some suggestions that an advance organizer properly constructed and presented in advance of the film showing might lead to greater teaching efficiency (Chang, 1982; Bunson, 1978; Montano Medence, 1974). Ausubel (1978; 1963) proposed that cognitive structure could be manipulated to facilitate the reception and retention of new material. He suggested that special introductory passages which he called advance organizers could be employed to provide the learner with the appropriate subsumers for subsequent learning tasks. Theoretically, the advance organizer provides concepts under which the details in the learning passages can be subsumbed. An advance organizer was initially conceived as a pedagogic device to be employed with written task. However, an extension of an advance organizer to film design and utilization was found various studies. Bunson (1978) devised a brief silent motion picture film and attached to the main body of the film that he used for his study in order to give a brief overview of the film content. He found that the advance organizer was effective in teaching the sixth graders with a social science film. Chang (1982) found that the advance organizer was effective in increasing the learning and retention of the consumer education film by the regular and educable mentally retarded children in a mainstreamed classroom.

This study attempted to verify whether a non-print advance organizer would raise the effectiveness of a science film when it was presented prior to the film showing to college freshmen. Specifically, this study focused on two questions. The first question was whether an advance organizer could aid in greater acquisition and retention of facts and concepts acquired from a science film than could be obtained without such a device. The second question was whether the use of an advance organizer would have a differential facilitative effect with groups of learners, namely, high ability group and the low ability group as measured by grade point average. A non-print advance organizer used in this study referred to a set of tape narrated 2"x2" color slides presented in advance of a sound film from which the slides were made to give a brief overview of the film.

Method

The subjects were sixteen undergraduate students. All subjects were white and primarily females who volunteered to participate.

A short version (twenty-three minutes) of the film, Birth of a Brain (1982), produced by Les Films due Levant was selected for this study. This film presented the prenatal and postnatal development of the human brain.

A non-print advance organizer consisted of two parts: one part was a series of 2"x2" color slides made from selected frames of the film, and the other part was a script written around the major concepts of the film at a higher level of generality, inclusiveness, and abstraction than the film script itself. A female read the organizer script onto an audiotape (2 minutes in length).

To obtain a learning test to provide information about groups and treatment differences, a pretest consisting of thirty-three items were given to fifty-one students enrolled at the same institution after they previewed the film in question. The final form of the five-option multiple choice test consisted of twenty-five items yielded Kuder-Richardson-Hoyt reliability estimate of .59.

A 2x2 factorial design was utilized with ability levels (high x low) and presentation modes (advance organizer plus film x film only) as independent variables, and the posttest scores as dependent variables. All subjects were assigned randomly to the four groups--two high ability groups and two low ability groups as measured by grade point average. Means of grade point average of each group on a nine-point scale were as follows: advance organizer group with high ability subjects (8.4); advance organizer group with low ability subjects (6.6); control group with high ability subjects (8.4); and control group with low ability subjects (6.8). Each pair of the high and the low ability groups received one of the treatments: advance organizer plus film and film only. The learning test was administered to all subjects immediately after the film presentation to test the immediate retention and two weeks later for delayed retention. To minimize individual differences due to speed factor, no time limit was given for completion.

Results

An ANOVA (equal n) was performed separately on the test data obtained from the immediate- and delayed-retention tests. Sixteen observations were included in the final analyses. Means and standard deviations on the tests were presented in Table 1; and the results of the ANOVAs were reported in Table 2 and Table 3.

See Table 1, Page 48

The results of this study indicated that significant difference in learning and retention was found among presentation modes. The Tukey Test was then applied separately to the data obtained from the immediate- and delayed retention tests to determine between which means this difference existed.

See Table 2, Page 49

The results indicated that on the immediate retention test there was a significant difference between the organizer group with high ability subjects and the film control group with high ability subjects, and between the organizer group with high ability subjects and the control group with low ability subjects. The difference between the means of other groups was not significant.

See Table 3, Page 50

The results of the analysis on the delayed-retention test data indicated that there was a significant difference between the organizer group with high ability subjects and the control group with low ability subjects, and between the organizer group with low ability subjects and the control group with low ability subjects, and finally, between the organizer group with low ability subjects and the control group with high ability subjects.

Discussion

The results of this study indicated that the non-print advance organizer prepared for this study appeared to provide facilitative effect for both the high and the low ability groups in acquisition and retention of facts and concepts presented in a science film, and ability levels did not differentially affect the learning outcomes. These results are consistent with the results obtained by Bunson (1978) and by Chang (1982) who experimented the non-print advance organizer with a social science film and a consumer education film respectively. Perhaps, a possibility that the better performance was simply due to being exposed to extra content material, such as an advance organizer, must not be ruled out. A meta-analysis review study indicated that an advance organizer showed a lesser tendency to facilitate learning when the control group studied the learning materials for a period of time equal to the combined time the experimental group studied the advance organizer and learning material (Kozlow, 1978). It is interesting to note that no interaction between the advance organizer and the ability levels was found. Other researchers (Chang, 1984, 1982; Moor, 1982; Lucas, 1972) have obtained similar results.

Since the results of this study suggest that learners from a wide range of academic and intellectual abilities might benefit from the use of non-print advance organizers which provide the learner with conceptual relationship of the film content which is hierarchically arranged, this implies that the students may learn more and retain longer the information presented in a film if an instructor provides them with appropriate advance organizers in which new concepts are subsumed in an appropriate location in the learner's cognitive structure. Furthermore, the instructor might be relieved of the responsibility of always previewing a film before showing it to a class. Further research is needed.

References

Arwady, J. (1978). Comparing the instructional effectiveness of four types of oral introductions to an instructional film. Unpublished doctoral dissertation, Ohio State University (Columbus).

Ausubel, D. (1963). *The psychology of meaningful verbal learning*. New York: Grune and Stratton.

Ausubel, D., Novak, J., & Hanesian, H. (1978). *Educational psychology: A cognitive view* (2nd ed.). New York: Holt, Rinehart and Winston.

Baldwin, T. (1968). Redundancy in simultaneously presented audiovisual message elements as a determinant of recall. ERIC ED 031 933.

Bunson, S. (1978). An investigation into the effect on learning from a sixth grade social science film by adding short motion and filmographic advance organizer. Unpublished doctoral dissertation, Boston University (Boston).

Chang, M. (1984, September). Teaching college freshmen with a science film. Paper presented at the annual convention of the Mid-Western Educational Research Assocation, Chicago, Illinois.

Chang, M. (1982). The effects of filmic advance organizers on acquisition of facts and concepts learned from a sound film by regualr and mainstreamed educable mentally retarded children, University of Tennessee (Knoxville).

Kantor, B. (1960). Effectiveness of inserted questions in instructional films. *Audiovisual Communication Review*, *8*, 104-108.

Kozlow, M. (1978). A meta-analysis of selected advance organizer research reports from 1960-1977. Unpublished doctoral dissertation, Ohio State University (Columbus).

Lathrop, C., & Norford, C. (1953). Contributions of film introductions and film summaries to learning from instructional films. Instructional Film Research Reports, 1.

Lucas, S. (1972). The effects of utilizing three types of advance organizers for learning a biological concept in seventh grade science. Unpublished doctoral dissertation, Penn State University (University Park).

Montano Midence, R. (1974). The effects of an audio-visual advance organizer upon the learning of permutations. Unpublished doctoral dissertation, University of Texas (Austin).

Moore, G. (1982). The effects of an advance organizer on students differing in prerequisite skills and knowledge. Dissertation Abstracts International, 43, 66A.

TABLE 1

Comparison of Means Scores on the Dependent Variables

A. Immediate Retention Test Scores

Group	Mean	S.D.
1[a]	15.0	2.16
2[b]	11.8	0.91
3[c]	13.0	1.15
4[d]	11.0	1.40

B. Delayed Retention Test Scores

Group	Mean	S.D.
1[a]	13.8	0.50
2[b]	11.0	2.45
3[c]	14.5	2.38
4[d]	10.8	1.89

[a] Advance organizer group with high ability subjects

[b] Control group with high ability subjects

[c] Advance organizer group with low ability subjects

[d] Control group with low ability subjects

TABLE 2

Results of ANOVA on Immediate Retention Test

SOURCE OF VARIANCE	SS	df	ms	F	p
Presentation modes	27.57	1	27.57	12.36	$<.01^{**}$
Ability levels	7.57	1	7.57	3.39	n.s.
Ability x Modes	1.55	1	1.55	0.70	n.s.
Within groups	26.75	12	2.23	-	-
Total	63.44	15	-	-	-

TABLE 3

Results of ANOVA on Delayed Retention Test

SOURCE OF VARIANCE	SS	df	ms	F	p
Presentation modes	42.25	1	42.25	10.89	$<.01^{**}$
Ability levels	0.25	1	0.25	0.06	n.s.
Ability x Modes	1.00	1	1.00	0.26	n.s.
Within groups	46.50	12	3.88	-	-
Total	90.00	15	-	-	-

TEACHING, TECHNOLOGY, AND THE MEDITATIVE PAUSE

by

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TEACHING, TECHNOLOGY, AND THE MEDITATIVE PAUSE

Because I want, a little later, to caution us all against a peril against teaching contained in the nature of some technological change, I should declare at the outset that I'm not inevitably on the side of the past. Television, word processors, and computers are not the instruments of the devil. We'd be safe, too, if the devil should take up video games: he'd be too busy to go about his customary satanic rounds and to do his regular satanic mischief. The word processor I am acquainted with and I sometimes square off against each other, and I lose. It has, so far, eaten three papers, two desk blotters, and one necktie. Nevertheless, I think I enjoy most change: I like the coffee pot that keeps my coffee hot without my chopping wood and tending a fire, and, if presented a choice between indoor and outdoor plumbing, I think only the innocent or the masochistic would have any trouble choosing.

The spectacle of rapid change is interesting to watch, and I can usually manage to enjoy it. I do, however, want to raise some cautionary signals. I think we should remind ourselves that most changes aren't pure. What is, as I'll try to show later, even the best changes are sometimes mixed with bad, particularly in the loss of some former good. I think, second, that we should notice that we are,oftener than not, focusing too exclusively on computers and word processors as agents of change. A hurry is on us to become "computer literate" and otherwise ready ourselves for tomorrow. The catch is that tomorrow and the day after are already here with some changes we haven't taken time to notice and to understand sufficiently. Rapid change has come before, and we have missed in our focus. We cite, rightly enough, the development of the printing press as the beginning of great change, but we forget that nothing like mass communication was possible until expensive silk paper had been replaced by relatively inexpensive wood pulp paper, which is what really released the print explosion in the 18th century. And now, we fail to take notice that the computer is not uniquely responsible for the so-called "information explosion" with its potentially great benefits to teaching in the late 20th century.

I am puzzled when I note that the terms LOW TECH and HIGH TECH have been appropriated for use almost exclusively in talking about computer technology. A university can have five large buildings filled with the most incredibly sophisticated kinds of technological equipment for use in the study of biology, chemistry, physics, geology, and other subjects, and still be regarded as a LOW TECH school unless it has the right kind of main frame with 1257 K power and 902 outlying terminals attached to it plus any number of silicon chips and buffalo chips. I suppose it's because computer technology is so new to us and seems to have such diverse applications that it overwhelms all talk of other technologies.

To be sure, computer technology has brought with each stage in its development marvelous changes in its capacities and in ours. In my own field, two journals, College English and College Composition and Communication, have already begun publishing papers about the uses of word processors in revising written work and about other uses of technology in remediation and in dealing with particular problems in writing. I'll digress a moment to say that better machines probably won't make your students much better as writers. The evidence is before you every day in your daily newspapers. Most newspapers are long since equipped with video display terminals and word processors, but your daily paper probably doesn't read much better than it formerly did. Better machines probably won't make students better writers; better teaching better equipped will.

At any rate, I think we need for a moment a different perspective that will let us see that computer technology, while central, is not the only technology that will influence us for good or bad as teachers, a perspective that will let us see that no mechanical change is un unmixed good.

A little earlier, I said that the computer is not solely responsible for the information explosion that continues to detonate around us. In this country last year, about 40,000 books were published; over 25,000 periodicals, about 1300 daily newspapers, some 3000 weekly newspapers were also published. About 7000 radio stations and some 1000 television stations were broadcasting, and about 13,000 films (counting all kinds) were made. But even if we consider machine technology alone, the computer alone is not responsibile for the explosion we see and hear--electric typewriters and photocopying machines have done their part, we can be sure.

Nevertheless, HIGH TECH is the issue, and to most, that means computer technology, together with other electronic communication systems that are developing. Every day we are being startled into self-consciousness by signs of rapid technological development as first one corporation, then another, first one university, then another announces surprises. Where rapid development does not yet reach, it is longed for. In an age of technology, technological development is the signal of civilization, the path for aspiration, the sign of superiority. All ages, to be sure, are technological ages in one way or another, but in former ages technology has commonly moved more slowly so that it was possible for us to accumulate gradually its appurtenances and methodologies. Modern technology, however, does not offer us a tool at a time to adjust to slowly; instead, whole systems of method open up to us between the time we leave off schooling and take up working. Our way is technological, and it is rapid, and we accept it as appropriate. It isn't always.

Increasingly sophisticated technology is not an unmixed blessing. Few advances are. The typewriter is undoubtedly a blessing, but it may be responsible for the general shortening of our sentences, where a quill pen might have encouraged slow meditations prior to writing, longer sentence building, and sonorities that we seldom hear now. Nevertheless, we do have to consider how thoroughly the students who come to us already live within an information system, or soon will. In 1978, Rep. Lionel Van Deerlin, chairman of the house subcommittee on communications, predicted that the new video options will "transform not only the face of broadcasting but the lives of Americans as profoundly as the Industrial Revolution of the nineteenth century." The optical fiber developed by Bell Laboratories is designed to be folded into a telephone line so that a single line could conceivably provide all of a family's phone messages, a multitude of TV shows, and, if linked to a central computer bank, a vast range of domestic services. The students who come to us will increasingly be familiar with a world that includes fiber optics increasing the channels on a television set a hundredfold, two-way cable television, satellite transmission, home video recorders, video disk players, portable video cameras for home-made productions, electronic data transmission that gives viewers the ability to call up on the screen a wide range of material, including news reports, market information, or reference material from an information bank. We're not, of course, beyond confusion in all of this. For example, there is already confusion in regulations: if one sends a message by phone that results in hard copy at the other end, is that a phone service or a mail service? The Federal Communications Commissions and the Postal Rates Commission sued each other to find out.

But I must turn to where I wanted to be from the beginning. There is another line of revolutionary technological development that we have not considered sufficiently. It is as significant as the changes brought about by computers, in some ways perhaps more significant. The changes it brings, like those effected by computers, are not unmixed goods. I am referring to the various processes of minaturization made possible by developments in high reduction photography. I will, in what follows, refer only to technology that already exists.

Microfilm was the herald of a new age in miniaturization. High reduction photography has, however, gone much further. The first stage was the development of microfiche, which made it possible to put an entire book on a single small film card. Then supermicrofiche made it possible to pack 1000 page images into the space provided by a single 3" x 5" film card. That's the equivalent of three or four fair-sized books. Then reader-printers were developed that would make hard-copy printouts of any page or pages, bringing them back to approximately their original size. Then ultramicrofiche was developed, making it possible to put up to 3200 pages on a single film not much larger than a large postage stamp. That's roughly the equivalent of seven to ten fair-sized books. Some years ago, Encyclopedia Britannica, Inc., offered for sale its first supermicrofiche collection, the Library of American Civilation. It contained 20,000 volumes numbering about six million pages, which on first sale went for $21,000, as opposed to the roughly $450,000 then required to buy the actual books. The books would require about 2000 feet of shelf space; the supermicrofiche collection requires 32 small card trays. National Cash Register Company now has some 70,000 volumes ready on ultramicrofiche, requiring still less space. Meanwhile, high reduction photography has also made it possible to store representations of about 8000 paintings on a single video disk.

Now if we add to the process of miniatruization the concept of networking, long since possible, we can imagine still more remarkable things, though we don't have to imagine them, for the technology already exists, though it is certainly not yet universally available. Such a scene as the following is already possible. Imagine one of our students in a dormitory room. He or she needs to study some particular subject, or needs to do a particular research project. The student goes to the console in the dorm room, summons up the attention of a machine in the university library, and tells the library machine to search out the pertinent materials for the subject or research project. When the library system has done so, then, at the student's pleasure, the material can be sent to the dorm room either on the screen or in hard copy. Portable sets, with console, screen, and printer--the whole not larger than an attache case--are also available, so that a student may have a convenient study center just about anywhere he or she pleases. If the student's own university library does not provide enough material, then he or she can ask the library system to search out other libraries, including the Library of Congress and the British Museum Library, with the material to be sent either on screen or in hard copy. Searching other libraries, however, may not be necessary. With the developments in miniaturization I mentioned above, it will be possible for any library to have all libraries stored away on ultramicrofiche.

This, I submit, is potentially a far more revolutionary development than the development of a computer that can store thousands of pieces of information and rearrange them on call or do 12,000 numerical operations in a second or two. Storing is storing, and numerical operations are numerical operations. Such computer actions make for a more rapidly-moving world, but I think they do not change the actual nature of the world. The miniaturizing and networking operation described above does, I think, induce some changes in the nature of things.

If our students' consoles connect them to the world's entire resources, how are they to go about their study? How are they to choose? Where are they to start? Where can they possibly stop? Can they study these resources in the same way they would if they were reading books and journals? By their size and nature, books and journals invite readers to pause, to re-read, to look ahead, to ponder; a terminal connected to all of the world's resources invites readers to keep going, as fast as possible, for there is always more to come. Does one kind of study entail the same kind of thinking that the other kind does? Probably, almost certainly, not.

Before I begin to sound too nervous about these changes, I should stop to declare that I do know these changes offer great bounty, incredible bounty. No teacher, I think, would have to be taught to be grateful for such bounty. Any school, any little town, can have a great library and, with those video disks, a great museum. But as I have frequently said, few great changes bring unmixed good. In the midst of this bounty, there is also potential loss. The machine giveth, but the machine also taketh away. What seems like bounty can, in no time at all, seem like hopeless clutter. It's like my closet: there's so damned much there that I can't find anything. But something else waits, too, something potentially more perilous than clutter.

If we go into this new and bountiful world, we will gain great good; but unless we discriminate, we will lose great good as well--good that we cannot afford to lose and should not want to lose. Some of the offerings of machines today and hereafter are good--speed, accuracy, reduced drudgery, efficiency, plenitude. But some are also antagonistic to certain virtues we have long held dear. I want to single out one great good that seems threatened by the wildly multiplying resources presented to us by some of the changes I have mentioned. The goal I am talking about is the ideal of the examined life. It may seem paradoxical to claim that the technology that seems to offer more and more learning and experience works against the hope of an examined life. But I think it does.

Perhaps I can explain myself in this way. All of our forms of criticism, judgment, evaluation, and theorizing rest upon our ability _to pause_--that includes philosophy, scientific theory, literary criticism, social commentary, art criticism, music criticism, historical writing, and so on. None of these is possible without meditative pauses. To know a building's architectural character, we must look and pause and look again. To formulate a scientific theory, we must think and test and pause and think again. To know the nature of a poem, we must read and pause and re-read and jump ahead and pause and read again. But electronic devices promise speed, near-simultaneous answers to our questions, and--with the aid of high reduction photography--a perpetual openness to a multitude of experiences and evidence. Electronic devices will not become more primitive. They will become more sophisticated and more accessible to us all--provided, of course, that electricity keeps coming to the plugs in our various walls. All the more recent forms - movies, television, ultramicrofiche's green shadows flickering on a screen--doe not allow the same kind of meditative pause that print allows. Of course, when you use a movieola, it is possible to study a film frame by frame, but when you do that, you're no longer studying motion pictures. Print allows us to turn backward or forward, to stop, to finger, to re-read. We may soon be able to do that with electronic communication devices, but it is their nature to move, to keep going. In our experience with electronic communication devices, the need is to hurry, to plunge into experience, to expose ourselves to as much as possible.

But we must pause. We want to lay ourselves open, to expose ourselves to an ever wider and deeper range of experience and information, to plunge, to turn on, and on. Yet if we are to be human, there comes a time to stop, to pause. If we commit ourselves to the hurrying world of electronic devices, then sooner or later, if we remain open to a life of multitudinous, whirring experience, we cannot and will not make judgments, we cannot have priorities, we cannot act, we cannot speak. The examined life requires both openness and closure. We educate our choices by an openness to earth and all, but then, as we are human, we pause, judge, speak, act, and start anew to educate our choices.

I'm not here, I hope you will remember, to curse change. To be sure, it does sometimes seem that when everything is available, it's just about as hopeless as when nothing in available. To be sure, the sheer copiousness of information can make it seem that we must hurry on and on and be swept in a swirl of clutter. It needn't be that way if teachers remember that we must stop and be human. I don't have to accept and to enjoy all change, but as a school teacher I do have to see to it that as far as it is in my power, any student will have the chance and the ability to consider and to evaluate and use all change. If I'm good at my work, most of it will become obsolete.

That makes the future risky. It's always asking us to become something we are not. At any given moment, the future can look look grim and difficult to cope with. Indeed, since going into the future means becoming something other than what we are now, it can always look grim unless someone makes it look otherwise. A future always happens; a good future has to be made.

Future-making is teacher's work. Wherever he or she happens to be located, whatever he or she happens to be called at the moment, it's always a good teacher, not technology alone, who helps us make the future. Some teachers, of course, just keep reiterating the past. Some simply grab the prevailing fashions of the present. Good teachers make the future by thinking, not by piling up data. They know, I think, that if we lose the meditative pause, we will have lost something dear and that, for good or bad, we will become something quite unlike ourselves. That may be all right, but we must pause to know whether or not it's all right. Because we are mostly pretty complex, we are easily lost to each other. Sometimes our vanity teaches us that other people are only what we perceive them to be, and we lose each other by our ignorance, our unwillingness to search each other out and to know each other. Sometimes we are apart, sometimes forlorn, sometimes afraid, but a good teacher can teach us to learn from others, to take the encouragement we need from others, to plug into distant and mysterious terminals, and all the while to pause, to ponder, to think.

A good teacher can teach us to know that each of us is blessed with a startling gift: each can be his or her own advocate, judge, critic, spokesman. A good teacher can teach us that change did not cease when it reached us, that we can go into a new world clasping to our memories what was dear in the old, but expecting to make magic hereafter. A good teacher can teach us that it is all right to question orthodoxy, that everything is full of wonder if we watch, that creation is too rich and varied and copious to be comprehended by single visions, that we must see and hear those visions from distant terminals, that we must then and always pause to think and re-think. There are many ways of looking, and a good teacher can show us many visions, each holding something precious and dear, that we must pause to consider and not accept simply because they come to us on the newest wire from the farthest terminal. Good teachers have the surest, boldest, loveliest validation for their work. Teaching by its nature takes hold of the past in order to proclaim and to create the future. However dark the time may be, however many signals reach us from distant electronic storehouses, it is good teachers, not technologies, that are always making the future. When they refuse to lock themselves into some pattern of the past, when they refuse to acquiesce meekly in prevailing fashions or technologies, when their own behavior is self-luminous because they race to learn but pause to know and to teach, then good teachers will teach us to make a brighter future than any we can no imagine.

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THE CONCEPT OF THE RIO GRANDE INSTITUTE

by

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THE CONCEPT OF THE RIO GRANDE INSTITUTE

The issue which I shall discuss today is the growing need on campus to deal with convergences of the various intellectual disciplines at the frontiers of research. This is a subject which is widely recognized and discussed with respect to activities in applied science and technology but which deserves much closer attention in basic research. I shall describe a new concept in graduate teaching and research, the Rio Grande Institute, which is designed to help meet this need and which will address opportunities and problems arising from the increasing involvement of science in all aspects of society.

It is useful to begin with a consideration of three types of research organizations with different objectives and research styles. Industrial laboratories are designed to carry out interdisciplinary development on relatively short-term projects with tangible outputs. They depend on groups of engineers and applied scientists who pool their skills to achieve practical objectives. In contrast, academic research groups focus on basic understandings of theory and process. Interdisciplinary research is not common in such groups. Los Alamos exemplifies a hybrid of these two types. It is a government-owned, contractor-operated ("GOCO") laboratory. Its activities range from basic research, appropriate for any top-level campus, to very applied programs, not greatly different from prototype production efforts in industry. The Laboratory also conducts extensive field operations. I shall discuss it a little further because it spans the full breadth of research styles.

At Los Alamos it is necessary to create and manage team enterprises using personnel who are, in many cases, academically oriented. Success commonly depends on development of basic theory. Identifying and motivating the necessary scientists, frequently people who are highly self-directed, can become crucial. Most mission-oriented laboratories look to academia for this part of the job. However, the long-term, risky nature of the typical Los Alamos mission requires placing special emphasis on devising effective ways to conduct interdisciplinary research with the kind of scientists who can satisfy these special requirements.

Top-level scientists who place great value on self-direction tend to pursue their careers in academic research groups and usually avoid teams. There are, of course, examples of team research in academia, for example, the large groups of academic scientists that typically carry out experiments in high energy physics. However, academic teams are usually dominated by a single scientific discipline. They involve the engineering disciplines as leaders only in highly applied research centers. Generally, the traditional autonomy of academic research helps to discourage broadly interdisciplinary efforts.

In recognition of this problem, it has become increasingly common to establish interdisciplinary research centers on campus. Most of them emphasize applied science and technology but a few conduct basic research. Such truly interdisciplinary basic science centers encounter serious problems which appear to stem largely from the traditional discipline-based structure of their home institutions. They have little influence on teaching policy and are not regarded as central activities. The departmental paths to tenure and recognition remain unchanged. The junior faculty can easily jeopardize their academic careers by moving to interdisciplinary borders, to "queer" subjects. It seems quite unlikely that these problems will be solved within a conventional academic framework.

Recently, additional sources of money have become available from the National Science Foundation and a few other federal agencies for the establishment of interdisciplinary centers with engineering themes at selected universities. An important objective in these centers is to close the gap between the academic and industrial styles by promoting a more collaborative team approach to some aspects of applied science. It is likely that useful progress will be made although the problems of brokering high-level scientific collaborations on campus may be considerably underestimated by academic administrators. Nevertheless, a new and imaginative effort along such lines is necessary and timely.

The present situation can be summarized as follows:

> Each of the types of groups or laboratories we have considered is presumably competent to plan interdisciplinary research within the context of its own programs and interests. However, interdisciplinary programs are usually undertaken when the team is mission-oriented and the desired output is well-defined. Such programs are characteristically industrial and are largely staffed with engineers and applied scientists.
>
> National laboratories usually are assigned longer-term programs requiring significant inputs of new knowledge derived from basic research. Their professional staffs include scientists who conduct the necessary basic studies. Such organizations can provide a very rich environment for nurturing effective interdisciplinary collaborations. But it is difficult to mandate interdisciplinary collaborations in basic research. Industrial management techniques become inappropriate and have been successfully modified at very few laboratories.
>
> The more advanced the interdisciplinary research area, the more likely it is that the individual parts will be pursued in an academic style, usually fragmented among the disciplines and scattered among various campuses. Occasional efforts at communication between disciplines occur at workshops and conferences with broad agenda. The yardsticks of success on campus are excellent students, superior

> intellectual output, and peer approval. In such an environment interdisciplinary organization is not likely to flourish.

Given this situation, is there any compelling reason to propose new options in our current research structure? The traditional way to pursue basic research has worked so well that it almost demands to be left alone. Certainly, if anything new is to be done, it should not weaken the present system. Accepting the constraints implied by this caveat, I believe that a serious deficiency exists in the conduct of advanced interdisciplinary research and that additional options are badly needed. Ironically, the problem derives its urgency from the very successes of modern science.

Striking convergences in the traditional disciplines are occurring at an accelerating pace. Rich new subjects are emerging, representing in many cases wonderful opportunities for vitally important research. These subjects appear to be highly interdisciplinary in traditional terms although they do not join the whole of one discipline with another but link particular subfields. The parts shift and change, constantly forming new patterns. The subject matter is usually categorized as basic research and choices are made and pursued by highly talented individual investigators. The contribution which is made to a common theme by one discipline tends to be uncoordinated with related work in other disciplines and is not likely to be quickly available outside the usual publications within that discipline. Sooner or later connections are made. A growing pattern of such connections defines an emerging synthesis. Frequently these syntheses can have important effects on society.

We feel a sense of urgency in devising new ways to nurture emerging syntheses because the international competitive environment has shortened the time frame for developing those aspects of science which are important to our economic strength, physical security, and national prestige. The length of time required to make the transition from a basic scientific discovery to a tangible payoff is constantly decreasing and it can no longer be safely assumed that the United States will lead the way. In addition, the sheer dramatic and intellectual appeal of scientific frontiers can affect the nature of our society. The growing circulation of science-oriented publications is not based on economic or military considerations but is probably evidence of an increasing ability to understand science at a popular level. Greater public understanding of science can contribute enormously to responsible policy-making.

The organizers of the Rio Grande Institute are proposing a fresh, unconventional approach to education and research on a new campus. The Institute will have a number of objectives, not always fully compatible. We are attempting to create a graduate teaching and research school which can better deal with the problems discussed here. The Institute will focus on selected interdisciplinary themes across a broad spectrum of scientific and social interests. It will address issues arising from the growing complexity and reorganization of major aspects of pure and applied sciences and their relationship to issues confronting modern society. It will reexamine the familiar problem of depth versus breadth in the education of professionals. The curriculum will reflect the expectation that some of our graduates will become leaders in government and industry.

The Rio Grande Institute will not provide the general course work that the typical undergraduate requires and it will not award a bachelor's degree. It will not have formal departments and will not emphasize full-scale lecture courses. Teaching will be accomplished in seminars, single lectures and short series of lectures, and above all by means of apprenticeship and research. Only the Ph.D. degree will be awarded, both in traditional and interdisciplinary subjects if they have become part of the Institute program. Faculty members learned in particular subfields, many with strong interdisciplinary interests, can be appointed without requiring balanced representation in the other traditional subfields. Research groupings will form according to the intellectual interests of the faculty and may vary with time. Only private funds will be sought for capital endowment of the Institute. Over a period of several years, as sufficient resources become available, it is proposed to appoint approximately forty senior resident faculty, some twenty non-resident fellows with qualifications comparable to those for senior resident faculty, some hundred junior faculty, tenured and tenure-track, and numbers of visitors and postdoctoral fellows. The student body will consist of some three hundred students, selected for their exceptional abilities, including the potential to benefit from an unconventionally structured curriculum and educational program.

In the immediate future, the Institute will initiate a program which merits support independently of its relationship to the eventual creation of a full-scale teaching campus. This program has the following features:

1. Emerging syntheses in science will be identified to which two or more disciplines can make significant contributions and which involve several people of great talent representing the contributing disciplines.

2. The principals will help form a "network" of appropriate members, perhaps twenty in number, who will conduct mutually supportive research in each of the important disciplines involved in the emerging synthesis. Some members of the network will work in part-time residence at the Institute; most will maintain full-time residence at their home institutions.

3. Some additional resources will be made available to members of each network, including the means to maintain

continuing communication through workshops, exchanges of campus visits, teleconferencing, and electronic mail distributed through networked personal computers.

Over a period of several years, this program will permit us to identify the most productive emerging syntheses. These will become major, continuing themes of the Institute and appropriate permanent staff appointments of senior and junior faculty will be made. We plan that by 1990 the Institute will be housed on its own campus and will be well started toward full-scale operation.

REACHING FOR THE POTENTIAL

by

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REACHING FOR THE POTENTIAL

Paul R. Dingman, Ph.D.

This discussion will view the goal of teaching to potential as being approachable via potentiation of the learner. This will require examination of three major variables: students' motivation, teachers' goals and teachers' power. In part, this may be done by comparing educational systems with economic systems.

Economic activity involves:

I. Capital, that is, unconsumed resources, in the form of savings, windfall acquisitions, or whatever. Unconsumed resources are used to secure whatever is needed for production. Capital can be land, structures, material, machinery, systems and knowledge, skills, and labor if stored up. Without capital, no productive activity, except gathering or hunting could take place. There is some question whether even gathering and hunting could be done without unconsumed sources, such as baskets or pots for gathering or rocks, clubs, or spear heads for hunting, and so on.

II. Labor, human effort applied to productive enterprise.

III. Management, the applying of capital and labor to productive enterprise.

IV. And finally, the one who uses the product or service. That could be called user ... but that has a

> negative connotation these days. A client? ... that's pre-empted by lawyers, social workers, and some psychologists who are afraid of psychotherapy, and maybe beauty parlors. Patron? ... that's pretty much reserved for the arts. So, we'll call it consumer.

It has been imagined that these components can be assembled hierarchically. Capital orders or directs management. Management orders or directs labor. Labor, or course, orders nobody. In the opposite direction, labor is responsible to management to produce, and management is responsible to capital for labor's production.

Where does the consumer come in? That's never been too clear. There have been radicals who thought the consumer might order capital to order management to do this or that. Chrysler showed how foolish that notion is. In the free American economy, capital is free to make whatever it feels like making, and government protects it from ... whoops ... errors. (In the Northwest, that is spelled WPPS, for Washington Public Power System).

The hierarchic conception of capitalism is only a few hundred years old. There is some question whether it ever was highly efficient. It was, after all, taking over from feudalism which was even less efficient. Perhaps, in years past, rapid expansion masked its inherent lack of utility. In any event, its flaws are now quite evident.

This has led to the emergence of a phenomenon most recently called "participative management". It is generally credited to the Japanese but there is some suspicion that they got it by reading old U.S. psychology texts. At any rate, participative management is now spreading through the United States--even to the stuck in the mud automobile industry.

Participative management certainly is more effective than hierarchic management. Not because it's a step in the right direction, it is not. Rather because it is a step sort of parallel to the right direction. It's not a step in the right direction because it still retains the notion that management "motivates" workers through arcane psycho-sophisticated manipulation.

There is some good news and some bad news about that. The bad news is that in truth, one cannot motivate workers. That is a fundamental psychological and economic law. The good news is that motivating workers is entirely unnecessary.

The reason it's unnecessary lies in one of the western worlds' best known secrets. Yes, everyone knows it. It is a secret only in that almost no one wants to admit to knowing it, much less to permit it to influence action.

The good new is that work is the human's single most important source of pleasure. (A detailed discussion can be found in Dingman, Paul R., Work and Psychological Well-being, A Theoretical Framework. Paper presented at Annual Meeting of American Public Health Association, Chicago, 1975.) It doesn't matter that people cannot be motivated to work because motivation to work is born in. One can permit people to work. One can provide tools, materials, etc., but one cannot motivate. Humans tend to work spontaneously unless prevented from doing so.

Understanding of this has made possible the emergence of "dofer" management. In these systems, the effective manager is at once an inspired, indomitable leader and a dedicated, reliable "dofer", that is one who considers "doing for" a noble activity. The good "dofer" puts own personal resources into action in representing the needs, the interests and the wishes of those being "did for".

Each other component of the system; capital, labor, consumer, recognizes the necessity for modifying or tempering some aspects of its initially perceived needs in the interests of developing a viable system. Each then instructs its "dofer", the manager, in making necessary modifications. The manager does for labor by insuring ready access to everything necessary for working, including intangibles, such as requirements, and goals, such as consumers to be supplied; does for capital by insuring that unconsumed resources increase rather than decrease; and does for consumers by providing adequate supply of high quality goods or services at minimum cost.

The effective manager strives to be in spirit the faithful "dofer" of each, taking care also that in outward visible action each can see its own faithful "dofer" at work (A more detailed discussion of the "dofer can be found in Dingman, Paul R., The "Dofer", a New Look at Management Style. Paper presented at Fall Conference of the Oregon Psychological Association, Kaneetah, 1984.)

Many universities can be translated directly into the hierarchic management model. Capital is represented by the trustees, management by the president and administration, labor by the faculty, and consumer by the students. The basic product is considered to be instruction. Major problems are: increasing production of instruction; reducing unit cost of instruction while maintaining quality indices, such as number of faculty doctoral degrees per square student; finding student consumers, and once signed up, getting them to make use of instruction. Finding a technically qualified labor force has not been a problem for some time now.

Quality of life in such universities is, at best, poor. Instruction is seldom inspired and often barely acceptable. That some of their students ultimately do well and make contributions can only be attributed to the fact that no school can keep one from learning, it can only make learning difficult.

Hopefully more typical are universities which fit a participative management model. Capital is again represented by trustees, labor by the faculty, consumer by the students, and management by president and administration. The latter, however, conceives of themselves as partners with the faculty. Well, maybe senior partners.

These systems are far more effective. Quality of life is good, they provide good quantities of good quality instruction. In all respects, they are superior to those previously described.

Still they are characterized by student bodies which can be charitably called "uninspired". These educational programs are mediocre ... not bad, just mediocre. They cannot achieve excellence because they have misapprehended the nature of the product of an educational system. Instruction is not an appropriate end product. Instruction can achieve excellence only in the context of concrete tasks to be performed. Learning is the proper product of an educational system.

In discussing motivation and work earlier, the term "work" should have been defined. Let us digress here for that purpose. By work is meant any purposeful application of personal resources toward a productive goal. That implies that an economic good is intended, but not necessarily one to the immediate advantage of the worker. Pay is not a part of the definition, not is "job" synonymous with "work". Indeed, much work goes on outside a job context, and there are jobs which do not permit work.

(Calling unpaid workers "volunteers" is an odd usage. It suggests that those who are paid are conscripted, forced into work.)

Obviously, learning can be subsumed under this usage of work, Learning is the principal work of the very young. All that has been said about work may be said about learning. That includes motivation. Motivation to learn is born in. Humans seek to learn, strive to learn, unless or until prevented from doing so.

(Work and play may be difficult to differentiate both in principal and in practice. Absence of economic gain, as in working a crossword puzzle, is typically the clue to play. Many activities involve both non-work and work, sensual experience and productive goal. Pottery might be an example. In some work activities, the goal is not tangible, as in skill acquisition or improvement.)

To return now to learning as the product of an educational system. Learning is the work of students. Students are analogous to labor in an economic system, and cannot be conceived of as the ultimate consumers. Society at large better fits there, but detailed discussion of that point will be deferred. The trustees may still represent capital, or at least access to capital, in our economic analysis of a university.

Faculty and administration then, jointly fit the role of management with administration properly being but a specialized offshoot of the faculty function. In those schools where administration has more bodies and a higher payroll that may be difficult to remember.

With this analysis, the application of the "dofer" management model is straight forward. The faculty is the "dofer" of the university. It does for society, the consumer, by ensuring the production of quality learning at minimum cost. It does for capital, the trustees, by assisting in the attracting of unconsumed resources and in balancing resource reserves.

With respect to labor, the students, the "dofer" provides everything necessary to produce: workspace, knowledge, skills, systems, tools, whatever may be needed for learning. Faculty is management, the servant of all components.

Of course, administration has carried out many activities traditionally associated with management, such as handling money. For that reason, it may be difficult to remember that administration in this management model is deputy, a subsidiary, of faculty in the servant-manager function.

Returning now to the means of potentiating the learning and our concerns for students motivations, teachers power, and teachers goals. We have already noted that motivating students to learn is unnecessary. Motivation to learn is inherent in the make-up of the human. Our task as teachers is to permit students to learn. Simple in principle, but somewhat difficult in application because most have been taught from childhood not to learn. Curiosity outside specified narrow areas is a punishable offense in most homes and in all kindergartens, elementary, and secondary schools.

"Do not ask about reproduction."

"Do not ask about far eastern religions."

"Do not ask about errogeneous zones."

"Do not ask to learn how to make explosives."

"Do not ask about bugs, slugs or toads."

"Time enough for such questions when your're older."

"You may not fool with geometry now. That belongs in the tenth grade. You have to have introductory algebra first."

"You may not look at algebra until you prove you can recite arithmetic."

"You may not learn comparative anatomy until you pass introductory biology."

Small wonder that most arrive at our university doors having forgotten they ever wanted to know anything. Small wonder that most are willing to be _taught_ the requirements for entry into a particular profession or occupation but show no interest in _learning_. Small wonder that the dissertation with its suggestion of independant learning is apprehended with such horror.

Given such circumstances, how can we serve students that they may under take learning?

We could start by tempering our pride in our ability to instruct; by reviewing our notion of the importance of what we have learned; by assuring ourselves we really are willing to have our juniors learn _anything_ they feel like learning; by convincing ourselves of our proper role as servants--intelligent, even brilliant, knowledgeable, skilled, maybe even wise--"dofers". Our attitude changes can form the social therapy which will reduce fear of learning and restore the inherent motivation for learning.

Is the idea of servant status, of being a "dofer" troublesome? Let's hope not. Some of the worlds most reknowned teachers have emphasized their servant roles. One insisted on washing the feet of the in-group of students, drying them with his hair. That may have been a bit too Hollywood for some of us, but it sure made the point.

Not only our attitudes, but our goals as teachers will require attention if we hope for our students to reach full potential for learning, if we hope to assist in that process, if we hope to potentiate.

For example, many of us are stuck with the "socratic error." We like to think of Socrates as one of the truly great teachers. We aspire to the socratic method.

Socrates encouraged students to think and to express their thoughts. However, in reading the Dialogues, it soon becomes clear where Socrates is going. He encourages students who express ideas heading in that direction, but he also puts down the others. In this way, students arrive at the conclusion Socrates wants. He has brilliantly led students to think, to express ideas, to learn for themselves everything he knows--a sadly limited goal.

What Socrates knows simply isn't enough. Each generation of students has the potential to reach beyond the known. Our fulfillment as teachers lies in the success of our students in grasping what we have not grasped. When we have served them in that, we have achieved a truly noble goal. If some of them then, having reached beyond us, become teachers with the same noble goals, we shall have defined the sublime.

Hopefully, none of what has been said suggests that teachers ought to abdicate power, If teachers are to influence the direction of events, and we should, power is a necessity.

In typical universities, faculty has exercised power largely through the setting of course requirements and prerequisites, and through evaluation of students. Other forces may sometimes override faculty in establishing curriculum, but very seldom in course requirements or prerequisites, or in the evaluation of students.

These are important functions. In setting course requirements, the faculty defines for students what they may expect, as a minimum, from the course, and what the School will aver to others that students have, as a minimum, gained from the course. In setting prerequisites for courses, the faculty advises students as to prior learning necessary in order to get their money's worth. In evaluating students, faculty advises as to the wisdom of further study in the area.

To see these as important exercises of power, however, is a serious mistake. On the one hand is the danger of diminishing the power of those who need it. For example, to continue or to dismiss a student on the basis of a grade is to take over some of the responsibility for learning or not learning.

On the other hand is the danger, our attention being deflected by these matters, that matters seriously needing the exercise of our power will suffer. For example, others may take advantage to make decisions, fait accompli, in matters such as relationships with trustees, with the general public or legislature, with the athletics people, and so on.

Finally, though, we have a much more important source of power. It lies in our role as servants, "dofers." Reflect for a moment on our dependance on those who serve us, such as those who supply electrical current, or our servants in medicine, waste disposal, transportation, food distribution, etc. In many respects, we are at the mercy of our servants.

Just so, other aspects of an education system depend upon us, insofar as we are good servants. Trustees are guided in their actions by our knowledge and judgment. The decisions of students are in large measure shaped by our suggestions, our advice, our example. The extent to which one reaches true potential for learning hinges on exposure to quality teachers.

INTEGRATING INFORMATION TECHNOLOGIES INTO LEARNING: THE BENEFITS OF THINKING STRATEGICALLY AND ORGANIZATIONALLY

by

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INTRODUCTION

We are in the midst of a computer revolution on our campuses that is, from all indications, inevitable. However, we must recognize that, while these changes will alter our institutions, the direction of these changes is not precisely known and is indeed subject to significant manipulation. The central proposition of this paper is that we must plan and manage wisely the changes that are emerging from the computer revolution, or we will subject our institutions to serious danger and miss important opportunities for institutional improvement. While the pressures on our institutions are less immediately negative than the campus unrest of the 1960's or the financial stresses of the 1970's (in fact, there are significant opportunities for institutional advancement), a prudent academic leader surely recognizes that institutional developments entailing major shifts of resources pose threats to an institution's finances, competitive position and organizational integrity. Are we prepared to manage this complex, large-scale revolution that is overtaking us? More specifically, are we prepared to manage this revolution so that the academic quality of our colleges and universities is enhanced? How do we assure that more effective and satisfied faculty and more competent and wiser students emerge from this period of change?

The organizational literature suggests that the effective institutional leader exhibits consciousness of internal and external forces, the capacity for strategic choice (determining a distinctive sense of direction) and the ability to organize goals, resources and management approaches.[1] The primary emphasis of this paper is the first aspect; that is, the need to know the institution's context and the forces and elements that shape both strategic and tactical decision-making. Several perspectives will be presented that are designed to identify important areas of decision and emphasis. Since it is assumed that many observers are actively engaged in assessing the technical implications of the computer revolution (microchip advances, cost reductions, technological capacities, literacy levels, job shifts), the major emphasis here is the internal context and the choices that we face on our own campuses. In addition, the paper will suggest some criteria for making decisions in various contexts and suggest the styles of leadership that best match our present situation.

Computers and Organizational Stress

What are the pressures that presently confront us? While awareness of circumstance and the ability to manage our destiny are crucial to effective leadership, we know that in times of stress and rapid change a leader's capacity to maintain consciousness and control is often reduced. On a daily basis, we saw Nixon's awareness of political reality and his ability to shape events ebb as the Watergate crisis unfolded over the months. During the 1960's, we saw Grayson Kirk at Columbia, Clark Kerr at Berkeley and many other college presidents make self-defeating decisions as they misread the forces around them and lost control of their institutions. In a more limited way, if we look carefully at the colleges with which we are familiar, we see considerable variation in the way they demonstrate consciousness and control.[2] We must be concerned about the consequences for a college or university when, for whatever reason, the institution's leaders lose effective consciousness and control.

An examination of organizational histories indicates that diminished leadership capacity is often coincidental with the following conditions: (1) strong and immediate external pressures, (2) institutional actors who move aggressively to achieve personal objectives, and (3) triggering events that present situations that are new for leaders and that force decisions that contain a higher risk of alienating segments of the organization.[3] In the face of these factors, leaders often show inflexibility and an inability to envision the future. The mix of a lingering unpopular war, a radicalized student minority and triggering events (such as the Kent State tragedy) presaged the leadership behavior and explosions on college campuses int he 1960's. In a somewhat milder form but no less consequential, many institutions in the 1970's were forced by enrollment shifts, economic pressures and leadership that lived too long by the expansionist mentality of the post-war period to recognize, first, that they had failed to see soon enough what was occurring to their financial position and, second, that they had to accept a loss of control -- for a time, at least -- of their institution's destiny.[4]

The relevance of these organizational dynamics is that, with the computer revolution washing around us, it appears that we are now entering a period in which external pressures are mounting and the demands on leadership are increasing. It is a period of danger, especially since it will be easier to respond in ways that are destabilizing and costly, and of opportunity, since with luck and resources, it will be possible to ride changes to institutional advantage. An important question is whether our institutions and our leaders -- at every level -- are capable of meeting this challenge.

What exactly is the challenge? Drawing on the three aspects mentioned above, the dynamics of change come clearer.

External Pressures -- cheaper computers, addicted users

The advancing computer technologies are producing more powerful, flexible and cheaper hardware and the potential for networking computers. The rate of change is almost unbelievable as enterpreneurial energy world-wide continues unabated. In due course, parents, children, teachers, school administrators, and the mass of citizens will be able to own a microcomputer. This mass market will eventually overwhelm colleges and universities.

An related aspect is that, as computer companies push their products, universities that move first are able to jump ahead of the market by purchasing computers at bargain prices and outpace adoption rates for the country at large.

Aggressive Actors -- unilateral initiatives by staff, faculty, students
Whether influenced by personal experience with the computer or holding a clear vision of the future, or both, individual members of the college community are acquiring computers, inserting them into their work, pressuring institutional resources and, in effect, moving off in their own direction. While in some cases, a dean or a vice president is dictating these events, the usual circumstance involves decisive action by many individuals at the grass roots of the organization. In addition, as these independent actors become more committed and entrenched, they become vocal political actors pursuing self-interested policy ends.

Triggering Events -- expensive decisions that affect institutional resources and staff
As the consequences of an uncontrolled institutional environment become clearer to leaders, as technological opportunities for creating "institutional" or system-wide solutions grow, and as institutional resources (such as mainframe computers and telephone systems) must be replaced and/or expanded, costly decisions must be made. Any such decision inevitably leads to a degree of resource and political shifting. Some backlash is inevitable. Furthermore, large resource decisions in a time of change are risky and these decisions can go wrong.

The challenge to leaders is to know enough about external and internal forces, and to make decisions that are wise and that sustain control over the destiny of the institution. The first and foremost ingredient of leadership, therefore, is consciousness -- consciousness of the evolving computer technologies, of applications to university activities, of the knowledge, experience and commitment of students and staff, of financial resources available to the institution, of the institution's competitive situation and market for students and funds, of the political situation of the institution, etc.[5] The thesis of this paper is that the more is known by as many institutional actors as possible, the more likely the institution will be able to cope with the dangers and opportunities of the computer revolution. Without this expanding knowledge base, it will be less likely that consensus will develop for major decisions and that the right strategic moves will be made.

Consciousness of the institution's situation implies comprehensiveness and specificity in the kind of knowledge that is acquired. The following pages present several perspectives suggesting the kinds of information that pertain to integrating computer technologies into the instructional environment.

Strategic Perspectives: Arenas of Analysis and Decision

When one speaks about the role of computers in instruction, one is talking primarily about the role faculty in the academic enterprise. For a moderate-sized comprehensive institution, the units of activity in a typical semester potentially include 700 faculty, 2100 courses and 7500 students. The most basic unit of analysis pertains to Faculty Member A in Course B engaged in Activity C with Student Group D. We must be concerned about the role of computers in each such arena. Are computers used? How are they being used? Has learning been enhanced? What are the costs? What is the overall cost/benefit ratio?

In addition, however, we know that other actors and arenas are inextricably tied to the activities of each classroom. Table A presents the range of computer-related activities and the range of key actors that intersect in the typical institution. Several insights emerge from this picture:

a. Computer development involves both the building of a campus-wide infrastructure as well as the design of learning in each classroom. Needless to point out, the two domains are interrelated and interdependent. However, it is essential to identify precisely where and how central planning and course planning are interdependent.

b. Given the interdependence of various aspects, an important requirement is to determine who should be involved in planning what facets of computer development. Table A includes an "X" at each point where an individual or group has a direct responsibility for making a decision. While from one point of view virtually every box could be marked, the marks seem to represent a minimum coverage of important

TABLE A

DECISION POINTS AFFECTING THE USE OF COMPUTERS IN INSTRUCTION

	Establishing an Infrastructure					Designing Teaching and Learning			
	Setting Institutional Goals	Providing Hardware	Building Data Bases	Designing Communi'n Networks	Training Faculty/ Staff/ Students	Setting Course Goals	Designing Course Plans	Selecting/ Developing Software	Choosing Learning Resources
Central Administration (President, Academic V.P.)	X	X		X					
Central Support (computing ctr., library, teaching support ctr.)	X	X	X	X	X			X	X
Academic Deans, Chairs	X	X		X	X	X	X	X	X
Faculty	X		X		X	X	X	X	X
Students					X				X

decisions. The implication of this picture is that in planning, for example, software development, central support personnel, deans and/or chairs and faculty must be involved. Only then will cost issues, resource issues, and pedagogical issues be considered in a unified manner.

c. It is clear that central support offices, academic leaders and faculty are directly involved in virtually every important decision to be made. This suggests that institutions must assure that every support staff person, every dean and chair and every faculty member using or contemplating the use of computers is educated to make good decisions. While faculty training is fairly commonplace, the systematic training of deans, chairs and staff personnel is often a missing element.

d. Insofar as Table A identifies important decision points for the design of learning, we must define the teaching/learning issues imbedded in each decision situation and develop pedagogical and technological criteria for making the wisest choices. Experience suggests that the guiding criteria should include three general areas of focus: pedagogical (What designs promote what kinds of leaning?), technological (What technological choices make the most sense in terms of maximizing effective learning and optimizing effective resource allocation.), and philosophical (What institutional values suggest directions of development and suggest areas that should be limited?). This kind of analysis (actually, a matrix of choices and criteria) can serve as a practical guide to faculty and academic administrators faced with the difficult decisions inherent in the information revolution.

A benefit of this comprehensive perspective is the ability to identify all the actors involved in computer development, the interdependence of these actors and the areas for planning and decision that are sometimes neglected. My review suggests that the most glaring area of neglect on campuses is the design of instruction.

Due to the emphasis in recent years on hardware advances, the activist inclinations of experimenting faculty and the general lack of instructional research, campus discussions have tended to lack specific references to pedagogical issues. While many faculty on our campuses have moved ahead energetically to exploit computer technology in their teaching, there has been little systematic examination of (1) the pedagogical implications of various course designs and of (2) the actual cost/benefits (human and financial costs/learning benefits) of utilizing computers in teaching.[6] For the benefit of users and non-users of computer technology, we need a sharper picture of the forces impinging on the instructional uses of computers and of the pedagogical choices that we face. At the outset, it is important to recognize that over the next three years large numbers of institutions will attain enhanced capacities for data communications and for linking microcomputers into a campus network. Three interlocking developments are producing this new information environment: first, campuses are implementing campus-wide data communication systems (e.g., the ROLM private branch exchange technology includes both voice and data communications capacities); second, traditional sites providing information for student learning are quickly automating their activities (e.g., the library, registrar, learning support center, career planning and even the classroom); third, microcomputers will expand in quantity and quality, especially as campuses embark on ambitious computer development plans and negotiate very favorable price reductions with vendors.[7] In short, many campuses will soon develop the infrastructure for integrating advanced computer technology into the conduct of teaching and learning, regardless of discipline or field.

The advancing technology presents a host of challenges for those responsible for designing instruction. It is apparent that most faculty and academic administrators do not grasp the implications for pedagogy of a campus-wide communications network that is tied to information repositories and computer stations. Therefore, it is important to analyze how instruction is being altered by these developments. We are well aware of the traditional elements of the campus learning environment and the patterns of communication that have connected these elements. Traditionally, college teaching and learning have included a student in residence (on or off-campus), a library, academic support sites (such as a learning skills center and a computing center) and the classroom. Students and learning materials move from site to site in accordance with the course plan and the decisions of the students. However, what is emerging is a technological overlay that may fundamentally reform how teaching and learning take place. Table B identifies the electronic network -- the overlay -- that is beginning to tie the campus together in very different ways. This picture assumes the following conditions:

a. More and more students will possess microcomputers and more computers will become available at sites across the campus. Ultimately, every student will have access to a computer whenever he desires with the possibility that every student will actually own a computer. In this eventuality, the residence hall may become the location for as many microcomputers as there are students.

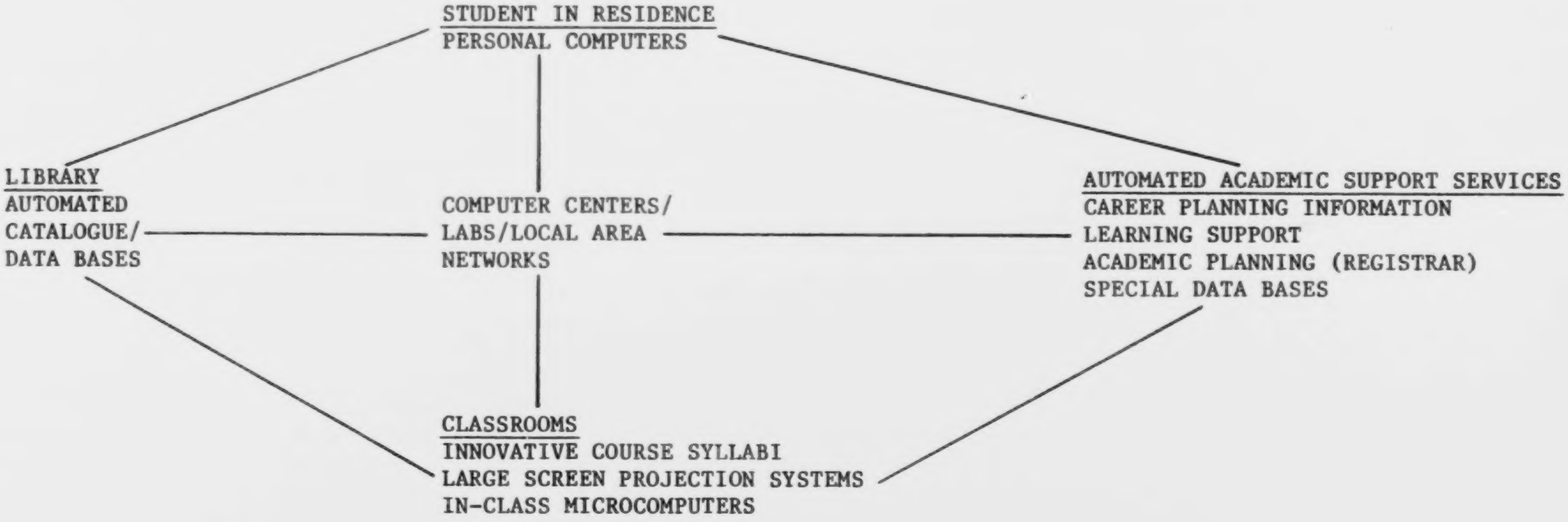
b. The movement to automate libraries will continue unabated and produce automated catalogues, newly accessible data bases on and off-campus and a library staff that is even more involved in the design of classroom learning.

c. Various support offices will automate aspects of their services. We see already that career planning offices, learning remediation programs and registrars are moving in this direction. What administrators in these areas have discovered is that certain kinds of information needed by students can be more efficiently transmitted and manipulated by means of computer technology.

d. The face-to-face interaction between faculty and learners in the classroom will gradually include additional technologies for supporting learning, including the use of microcomputers tied to each other and to mainframes, large screen projectors capable of showing the keyboard and output of a classroom microcomputer and mediated learning packages utilizing film, video/disc, computers and slides. In the short run, the advancing technology and shrinking price of the large screen projectors will be exploited on many campuses.[8] The large screen projector overcomes the problem of how to show to group the output of individualized, miniaturized technologies (i.e., the microcomputer). The limiting factor in upgrading classrooms is the relatively high cost of installing these technologies and the fact that most institutions have not ever budgeted adequately for classroom maintenance and improvement.

TABLE B

THE TECHNOLOGICAL OVERLAY: THE MOVEMENT OF INFORMATION THROUGH AN ELECTRONIC NETWORK


STUDENT IN RESIDENCE
PERSONAL COMPUTERS
LIBRARY
AUTOMATED
CATALOGUE/
DATA BASES
COMPUTER CENTERS/
LABS/LOCAL AREA
NETWORKS
AUTOMATED ACADEMIC SUPPORT SERVICES
CAREER PLANNING INFORMATION
LEARNING SUPPORT
ACADEMIC PLANNING (REGISTRAR)
SPECIAL DATA BASES
CLASSROOMS
INNOVATIVE COURSE SYLLABI
LARGE SCREEN PROJECTION SYSTEMS
IN-CLASS MICROCOMPUTERS

e. Finally, it is becoming possible and efficient to connect the various elements of this campus map. The ROLM private branch enchange technology permits the tying together of computers across the campus, whether in the dormitory, the library, an educational support office or the classroom. The implications for learning of this capacity will be discussed below.

While the present elements in this picture probably do not exist on many single campus, it is safe to assert that most campuses are moving in this direction. If this is indeed the case, it is useful to examine what campuses are doing already.

First, we know that hundreds of faculty -- perhaps thousands -- across the country have designed courses that utilize computer technology. With access to microcomputers or terminals and a mainframe, faculty have adopted or developed programs of considerable variety. Most applications have clustered around the following: high level analytical programs for the physical sciences and mathematics, packaged research programs for the social and natural sciences, non-technical programming in various languages for a variety of disciplines, packaged programs that teach an entire course (e.g. Plato), and various easy-to-use programs for word processing, accounting and data base management.[9] Assisted by computers, students have learned facts, solved problems, participated in simulations, done writing, build models, visualized new concepts and taken tests. Despite the multitude of experiments by faculty on campuses across the country, it is evident that existing faculty applications do not necessarily meet the needs or desires of any other faculty member. It is part of the academic ethic that every course has its unique set of goals and every faculty member has unique strategies and styles. Whether this belief system makes sense or not, we must recognize that little that has come before is directly useful to late arrivals to computer-aided instruction. If a faculty member is to "own" his course, he must build it himself.

A related issue concerns the fact that, despite many excellent precedents in the application of computers to teaching, available software remains limited in quantity, quality and variety. This explains why schools such as Carnegie-Mellon, through the Interuniversity Consortium on Educational Computing, and M.I.T., through its generously-funded Project Athena, are embarked on ambitious efforts to develop software of use to a variety of higher education institutions.[10] In the meantime, however, it is useful to make the assumption that, due to the stubborn independence of college faculty and the lack of immediately useable software, the development of computer uses will be accomplished mainly close to home, by our faculty, with the help of their colleagues. As inefficient as this route may seem (i.e., every faculty member inventing or reinventing his course), there are several important pedagogical benefits, including the following: the logic of the course remains the logic of the professor of that course; the faculty member carries an emotional commitment to the course by virtue of having constructed it; the faculty member must confront the inherent problems and contradictions of the course and take responsibility for successes and failures; and the faculty member retains the moral obligation to design learning that is responsive to his particular group of learners.

The development of courseware by faculty and by other groups is moving forward in sporadic fashion. Some campuses are making a comprehensive effort; most campuses exhibit small pockets of energetic activity and accomplishment. This pattern of sporadic progress is evident in the elements displayed in Table B — a very few campuses are moving systematically on all fronts; most campuses are making some progress in one or more areas. All of this suggests it will be a considerable time before fully-developed capacities in software, hardware, library automation, classroom technology and faculty and student readiness converge in any one setting. There is a danger that one sector of the campus will move ahead and drive, sometimes unwisely, decisions in other sectors. For example, whereas requiring microcomputers for incoming students in engineering may make sense, this may make no sense -- at least, for the next several years -- for students in the liberal arts. The task becomes that of moving ahead in such a way that the needs of each academic area and of each faculty member are accommodated. While a dose of competitive tension can be productive, it is important that computer development proceed from a realistic understanding of each area's readiness and from a case-by-case calculation of likely costs and benefits.

In looking at the range of actors and activities affecting instruction (Table A) and the elements of the emerging technological overlay (Table B), certain observations and principles have come clear. First, campus-wide decisions and course-specific decisions must be perceived as interrelated and interdependent. Second, implications for designing teaching and learning must be examined at each decision point, with reference not only to resource issues but also to expected or demonstrated benefits to learning. Third, we need to recognize that the primary agent for instructional change will remain the faculty member, and we must organize accordingly. Fourth, we must sustain a comprehensive view when planning computer developments so that change on campus can occur in a manner that is reasonably coherent and unified. Finally, if one grants that the overlay described in Table B represents the direction that the instructional world is moving, it is useful to imagine the likely long-term impact on the way teaching and learning will take place. One writer drew the following scenario:

> Students working in a computer-intensive environment will have opportunities significantly different from those of today. Sitting at desks in

> dormitory rooms, they will be able to use machines with analytic, computational, and design capabilities comparable to the best of those now available to working engineers. They will have access to extensive information services and data banks. They will be able to interact through the computer with other students and faculty and potentially with other individuals with similar interests anywhere in the world. And they will be able to use simulation and modeling software that constitutes a fundamentally new information resource.[11]

This quotation represents one view of the future. It may be incomplete; it may be overly optimistic; it may not be something we want. However, the point is that, unless we engage in similar futuristic thinking, we will fail to anticipate important possibilities and pitfalls. In short, we should recognize that we don't actually know much about the likely effects of computer technology on instruction and on our institutions and, as such, we should try to discern what changes are inevitable and what elements are amenable to our influence.

The Computer Revolution as an Organizational and Management Problem

While this paper has suggested several specific problems that must be addressed, it is beyond the scope of this paper (and perhaps any observer) to suggest "solutions" to these problems. The world is too complex, diverse and changing to attempt such an undertaking. In addition, it is certain that any accepted wisdom will be conditioned greatly by the special circumstances of each campus. Thus, the problem we face today is less the finding of solutions to specific computer questions -- we will reach answers but these answers will have a short shelf life -- than it is thinking wisely and effectively about how to approach the issue of computers. Thinking organizationally, what are the comprehensive pictures we need to carry in our heads and by what strategies do we manage the affairs of the institution? Having identified above two important pictures (Tables A and B), the focus of this section is on the right way to think about managing the computer revolution. Who should make what kinds of decisions? What kind of an organizational environment should we encourage?

The contemporary academic institution, especially the comprehensive university, is a diverse, horizontally-structured, loosely-coupled enterprise.[12] While an organizational chart might suggest that the president, academic vice president or dean is in a position to mandate activities, the actual decision process works quite differently. Except in a few selected areas, faculty have considerable control of their lives and are in a position to effectively veto almost any academic initiative that they do not like. Top level leaders may articulate a strategic direction but chairs and faculty must internalize the goal and its rationale before one can expect committed effort. Thus, on the rare occasions when a formal decision is made, the decision-making tends to be slow and consensual. Also, it is useful to recognize that many important shifts in direction occur, not by formal decision of the institution, but by the accumulated decisions of individual chairs and faulty. Frequently, decisions serve primarily to codify or marginally reshape patterns of behavior that already exist in the enterprise.

In this loosely-coupled enterprise, the decisions that shape the introduction of computers to a campus involve actors at the top-level and at the grass roots of the faculty. Presidents and trustees decide what mainframes to buy, what microcomputer vendor with whom to contract and whether to invest in library automation. Chairs and faculty decide whether and how to redesign a course, what software to use and how student learning will be evaluated. Despite the relative autonomy of presidents and faculty in making decisions in their special arenas, it is clear from the previous discussion that many important decisions are of direct interest to more than one constituency. Thus, an important organizational question concerns how to identify the right decision-makers on a particular issue and how to bring them together.

Another characteristic of the modern college or university is the prevalence of professional expertise. Staff members of the computer center, a few academic administrators, computer scientists and a handful of faculty in other disciplines are experts in various aspects of computers. Every faculty member is an expert in the discipline for which he was trained and conducts teaching. Each of these experts has a instinctive resistance to intrusions that affect his area of expertise. As a result, it is often difficult to get faculty and staff to benefit from each other's knowledge. However, we know that computer knowledge and knowledge of the discipline are both essential to planning a course that employs computer technology. A related problem is that many of the decisions pertaining to computer development have more to do with resource allocation, budget planning, the setting of priorities and educational policy than with computers *per se*. J. Victor Baldridge and his colleagues have described this issue:

> We have watched too many forceful administrators suddenly become intimidated when confronted with large-scale computer decisions. A baseline idea needs to be established. They key policymakers, even though nontechnical, are nevertheless experts about the *decision arena*. Fundamentally that is what we confront here: a decision arena focused on computers.[13]

Baldridge goes on to emphasize both the important role of non-experts in decision-making about computers and the essential contribution of computer experts who bring critical knowledge, experience and judgment. The overall management task is to bring *all* knowledgeable individuals -- computer experts, subject matter specialists, and key administrators -- into planning and decision-making.

The fragmented structure of the university, the interdependence of various constituencies concerned with computers, the rate of change in the computing world and the importance of the decisions to be made present a difficult management challenge. However, there is a convenient match between these conditions and the management approaches recommended by several contemporary management theorists. Twelve years ago Harlan Cleveland anticipated the management needs of the today's organization:

> The organizations that get things done will no longer be hierarchical pyramids with most of the real control at the top. They will be systems -- interlaced webs of tension in which control is loose, power diffused, and centers of decision plural. "Decision-making" will become an increasingly intricate process of multilateral brokerage both inside and outside the organization which thinks it has the responsibility for making, or at least announcing, the decision. Because organizations will be more horizontal, the way they are governed is likely to be more collegial, consensual, and consultative. The bigger the problems to be tackled, the more real power is diffused and the larger the number of persons who can exercise it -- if they work at it.[14]

Whether by choice or chance, it is clear that decisions about computers on many campuses are being handled in a manner suggested by Cleveland. While major resource decisions rest ultimately at the top, numerous individuals and units have a role in shaping decisions. An important question concerns whether this diffuse situation leads to clear choices that are in the best interest of the institution. This is a matter of leadership. Cleveland writes about the need to create "constructive ambiguity" and about the role of leaders in catalyzing consensus and decision.[15] However, more recent writers have improved upon this picture of the leadership function.

Writers such as Galbraith, Peters and Waterman, and Naisbitt call for the conscious design of the organizational environment, positive-thinking leaders who induce commitments to targeted projects and tasks, the building of coalitions and networks of individuals cutting across organizational lines (but relevant to the task at hand), and the development of human resources as the essence of organizational strength.[16] The computer challenge constitutes an ideal circumstance for trying these management techniques in higher education. Indeed, the computer issue represents our best opportunity in many years to undertake as an institution a program of change that is essentially positive and that may serve to unify the various constituencies of the institution. After several years of economic retrenchment, recurrent conflict between faculty and administration and an expressed sense of powerlessness on the part of many, we may be able to move our institutions back onto an agenda that is academic in nature and enhances the self-esteem of those involved.

In sum, our ability to meet the computer challenge depends on our ability to think wisely about the task and to induce effective leadership at every level of the institution. The evidence suggests that we now know enough about computing developments, about instructional requirements, about our institutions and about leadership to carry it off. If we do succeed, we will have overcome the worst fears of many by bringing computers to serve us by addressing our most critical human, educational and organizational needs. From this perspective, the opportunities clearly outweigh the obvious inherent dangers, and this is sufficient grounds for serious, institution-wide planning and commitment.

REFERENCES

1. See, for example, Galbraith, Jay, Organization Design, Addison-Wesley: Reading, Mass., 1977.

2. Some examples of this variation appear in Chaffee, Ellen E., Case Studies in College Strategy, NCHEMS: Boulder, Colo., 1983.

3. These forces are described in the Report of the President's Commission on Campus Unrest, published as special issue of College and University Report, Number 277, September 29, 1970.

4. See Mingle, John and Associates, Challenges of Retrenchment, Jossey-Bass: San Francisco, 1981.

5. Galbraith, Op. Cit.

6. See Ploch, Margie, "Micros Flood Campuses," High Technology, March 1984, pp. 47-49 and Friedman, Edward, "The Wired University," IEE Spectrum, November, 1984, page 120.

7. An excellent overview appears in Friedman, Op. Cit.

8. Sony now sells a high quality large screen video projection system for about $5,300. The unit may be permanently installed (at a higher price) or used as a mobile resource for classrooms across the campus.

9. This listing is contained in Baldridge, J. Victor, Roberts, Janine and Weiner, Terri, The Campus and the Microcomputer Revolution, MacMillan: New York, 1984, page 112.

10. See Friedman, Op. Cit.

11. Ibid.

12. See, for example, Weick, Karl, "Educational Institutions as Loosely Coupled Systems," Administrative Science Quarterly, Vol. 21, Issue 1, March 1976, pp. 1-19.

13. Baldridge, Op. Cit., Preface.

14. Cleveland, Harland, The Future Executive, Harper and Row: New York, 1972 page 13.

15. Ibid., pp. 24-27.

16. See Galbraith, Op. Cit.; Peters, Thomas and Waterman, Robert, In Search of Excellence, Harper and Row: New York, 1982; Naisbitt, John, "Reinventing the American Corporation," The New York Times, December 23, 1984.

HANDS-ON PROGRAM OF IBM-PC TRAINING AT LOS ALAMOS NATIONAL LABORATORY

by

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Abstract:

Since December, 1983, the Laboratory has offered introductory courses of IBM-PC training. A comprehensive needs assessment was conducted and a nine-course module of classes was designed and implemented. Forty classes were completed in the one-year period.

The target group includes the novice computer user in the scientific, management, administrative, and secretarial personnel groups.

The development, needs assessment, course implementation and design, course evaluations, and future direction of computer training will be discuessed.

Lab-automation, robotics, design of the lab and office and the impact of computer on society will be discussed briefly.

INTRODUCTION:

The PA-15 Training Office at the Los Alamos National Laboratory has as a part of its mission to develop human resources and enhance scientific excellence through various training programs.

During the past year approximately 900 IBM personal computers were purchased for use as personal workstations for laboratory employees. The Training Office received numerous requests for IBM-PC training and thus began the course developmental procedure to assess needs, design a module of courses, and implement and evaluate the courses. This process resulted in a nine-course module of forty instructor/hands-on instructional courses conducted from December 1983 through December 1984 for over 400 employees. The target for these courses was the novice computer user among the scientific, management, administrative and secretarial employee groups.

The following discussion will address these topics and briefly discuss the impact of the computer on society, design of laboratory and secretarial, and scientific office and laboratory automation.

COURSE DEVELOPMENT:

The development of courses at the Training Office uses the Instructional Systems Development procedures as shown in Figure 1. The development of the IBM-PC courses included a pilot course, a needs assessment, the course design, and implementation and evaluation of the courses.

Pilot Course: In December 1983 a pilot course in the Introduction to the IBM-PC was offered in the Los Alamos Training Office due to requests from personnel.

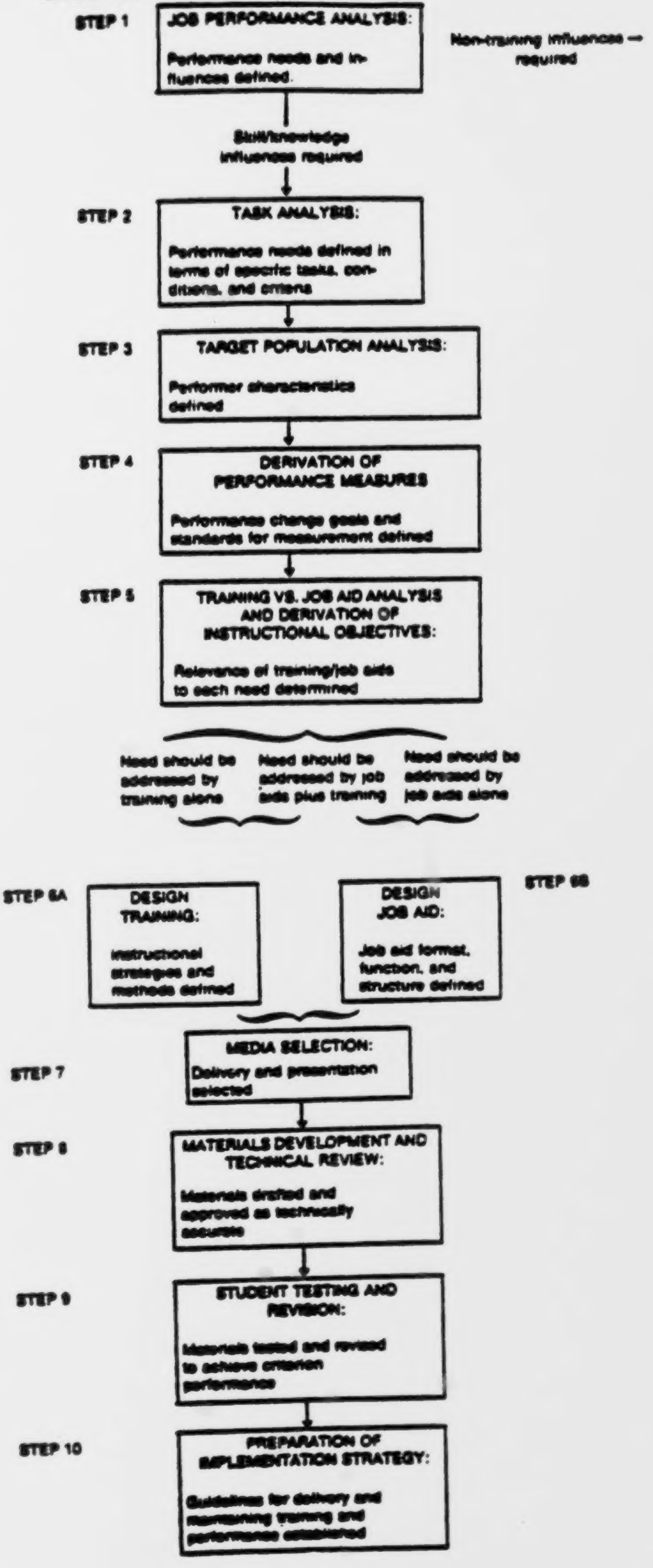
Purpose: The course was designed to teach the participant the fundamental concepts and terminology of the microcomputer field; the basic operations involved in day to day computer use (saving, retrieving, and copying files); the basic functions involved in operating a computer; minor troubleshooting of a computer system at an operator level; and an introduction to the use of applications programs such as word processing, data base management, and electronic spreadsheets.

The participants in the course had the opportunity to practice during the class hours under the supervision of the instructor. The course included several HANDS-ON ACTIVITIES to insure that each participant left with the ability to operate and use the IBM-PC in an independent manner.

Course participants will

- Have an understanding of the terms and the fundamental concepts of microcomputers.
- Be able to operate the IBM-PC and associated equipment such as disc drives, printers, and video monitors without assistance.
- Use the IBM-PC operating system to perform the basic functions of formatting discs, copying files, copying discs, and saving and retrieving files.- Use application programs such as word processing, data base management programs, and electronic spreadsheet programs.

Instructional Systems Development: Steps and Outcomes



STEP 1
JOB PERFORMANCE ANALYSIS:
Performance needs and influences defined.
Non-training influences → required
Skill/knowledge influences required
STEP 2
TASK ANALYSIS:
Performance needs defined in terms of specific tasks, conditions, and criteria
STEP 3
TARGET POPULATION ANALYSIS:
Performer characteristics defined
STEP 4
DERIVATION OF PERFORMANCE MEASURES
Performance change goals and standards for measurement defined
STEP 5
TRAINING VS. JOB AID ANALYSIS AND DERIVATION OF INSTRUCTIONAL OBJECTIVES:
Relevance of training/job aids to each need determined
Need should be addressed by training alone
Need should be addressed by job aids plus training
Need should be addressed by job aids alone
STEP 6A
DESIGN TRAINING:
Instructional strategies and methods defined
STEP 6B
DESIGN JOB AID:
Job aid format, function, and structure defined
STEP 7
MEDIA SELECTION:
Delivery and presentation selected
STEP 8
MATERIALS DEVELOPMENT AND TECHNICAL REVIEW:
Materials drafted and approved as technically accurate
STEP 9
STUDENT TESTING AND REVISION:
Materials tested and revised to achieve criterion performance
STEP 10
PREPARATION OF IMPLEMENTATION STRATEGY:
Guidelines for delivery and maintaining training and performance established

Figure 1

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- Read, understand, and make use of computer reference manuals.
- Recognize how microcomputers can be used in the office to increase both efficiency and productivity.
- Assemble and disassemble the computer hardware system and diagnose minor hardware and software problems.

The twenty-hour course was offered in two, half-day, five-day sessions, (morning 8 a.m. - noon or afternoon 1 p.m. - 5 p.m.) for a total of twenty-four employees. The class format was lecture/discussion and demonstration using video projection from the instructor's computer to two video screens in the room. Hands-on lab sessions were dispersed between the lecture/discussion sessions. Students were introducd to the use of the application programs of Wordstar word processing, VisiCalc electronic spreadsheets, Lotus 1,2,3, and PFS database management. The use of computer reference manuals, basic functions involved in operating a computer and fundamental concepts and terminology of the microcomputer field were discussed. The room consisted of six 30" x 60" tables with six IBM-PC's and 6 Epson RX-80 printers for a class of twelve students. The instructor met the requirements of educator and computer scientist with a college teaching background in computer science and math. He was familiar with Los Alamos National Laboratory as a former employee in the computing division. The instructor prepared a manual to accompany the lectures and provide hands-on activities.

Student evaluations of the pilot course were most favorable with the hands-on format, the friendly, unpressured atmosphere created by the instructor, and the individualized instruction available during the lab sessions. Overall evaluation of the course was very favorable but it was evident that a needs assessment of the future IBM-PC training requirements of over 900 Laboratory PC users needed to be completed before the course could be redesigned to meet personnel needs.

NEEDS ASSESSMENT

An assessment instrument (Figure 2) was design and distributed to various Laboratory groups using the IBM-PC. Results of the assessment were compiled from 99 completed and returned questionnaires. The computer use level of resondents was equally distributed between "very often", "often" and "sometimes". (Many employees have been using various mainframe computer systems throughout the Laboratory from Hewlett Packard, IBM, VAX, Cray but had no experience on microcomputers.) The level of operation and application understanding varied but most were in the "fair" category. Live instruction was preferred over videotape instruction. Half of the respondents indicated a need for immediate instruction and the remaining forty percent within 6 months, and ten percent within the year.

An important need was indicated by the assessment. The greatest need of respondents was for an introduction to the IBM-PC course followed by wordprocessing (Multimate). The second need was for an electronic spreadsheet (Lotus 1,2,3 preferred). The third need was for a database management course (Lotus 1,2,3 followed by PFS:File and DBASE II). The programming language courses most wanted were beginning and advanced BASIC and Pascal. Other courses suggested included: UNIX, "C" assembly language, MAPPER, INFORM, DOS, graphics, interfacing with the CCF (central computer facility), data transmissions (logging and autotype), hardware concepts (RAM, ROM, serial ports, Raster graphics, hard disks), interfacing peripheral hardware (plotters, digitizers), general information on IBM-PC software available, introduction of IBM-PC applications, night classes, and "live" advanced courses. This information was used to develop the nine-course module of Introduction to the IBM-PC classes.

IBM-PC TRAINING NEEDS ASSESSMENT

Los Alamos National Laboratory recently purchased a large number of IBM PC microcomputers for use by lab employees. More IBM-PC microcomputers are expected in the near future. The Training Office (PA-15) and C-10 are determining the training needs of all employees who use these microcomputers. Please give as much information as possible to help us provide the best training possible for Laboratory employees.

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1. Rate your own level of computer use. (Circle one)
   VERY OFTEN OFTEN SOMETIMES INFREQUENTLY NEVER

2. Rate your level of understanding the operation and application of microcomputers. (Circle one)
   EXCELLENT GOOD FAIR LITTLE NONE

3. Listed below are courses dealing with application of the IBM-PC microcomputers. Rate your need for each course on a scale of 1 to 5 (1 = no need, 5 = very needed).

	Your need	Needs of co-workers	Number of co-workers
Introduction to the IBM-PC			
Word Processing			
Multimate			
Wordstar			
Easywriter			
Other (specify)			
Electronic Spreadsheet			
Multiplan			
Visicalc			
Supercalc			
Lotus 1-2-3			
Other (specify)			
Data Communications			
Data Base Management			
dBase II			
Pfs:FILE			
Datastar			
Lotus 1-2-3			
Other (specify)			
Programming Languages			
Beginning BASIC			
Advanced BASIC			
Pascal			
Fortran			
Cobol			
Other (specify)			

Other Courses:
1. ______________________________
2. ______________________________

(use other side if necessary)

Figure 2

Would you prefer a live-course or self-study course? (Circle one) If self-study: CAI or videotape? (Circle one) Do you need instruction immediately or in future? (Circle one)

How critical are your instructional needs? (i.e. need now, 6 mo., 1 year) (Circle one)

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COURSE DESIGN:

Using information from the pilot course and the needs assessment summary, aspects of the course were re-evaluated and modifications for the new courses were considered. The use of video monitors to be daisy-chained from the instructor's computer to the student computer instead of the video projection of the instructor's screen and keyboard was reconsidered due to the poor resolution of the video projection onto TV screens. The pilot course contained students who were fearful and intimidated by computers. Some looked upon computers as monsters or as a necessary evil with which to deal. Therefore the class format was carefully considered, to produce a non-threatening, reassuring, supportive classroom atmosphere which would create the most productive learning environment for this type of student. It was suggested that the first few minutes be a friendly, get-acquainted, relax-with-a-cup-of-coffee time with the instructor. This was followed by a forty-minute lecture/discussion alternated with the hands-on lab sessions. Students were to be paired by their own choice to stimulate the learning process. Multimate replaced VisiCalc for more job relevance. The Introduction to the IBM-PC: Overview course materials were designed for the novice microcomputer user to meet the goals stated in the pilot program.

COURSE IMPLEMENTATION:

Course dates were set, rooms reserved, purchase requests for the instructional vendor and approvals completed. Courses were advertised in the Laboratory NewsBulletin, course flyers were distributed lab-wide and enrollments registered by the PA-15 secretarial support staff. Courses designed included the following: -

Introduction to the IBM-PC: Overview (20 hours)

Fundamental concepts of microcomputers, basic operating functions, introduction to application programs and use of computer manuals. Hands on activities. Recommended as first course for the non-user.

Introduction to the IBM-PC: Lotus 1,2,3 (16 hours)

Use electronic spreadsheets to solve problems of budget, project and personnel management; create and search data bases and graph data using pie, bar, and line graphs; hands-on activities.

Introduction to the IBM-PC: Multimate (16 hours)

Create and format short and long documents; use basic editing features of Multimate; use formatting features (change print sizes, bold printing, underlining, centering, decimal tabs, footers, headers, and pagination); create scientific documents (special symbols); create primary and secondary documents; merge and create repeating merged documents; copy and move text in documents; perform column addition; create libraries; and print documents; hands-on activities and assignments.

Introduction to the IBM-PC: dBase II (20 hours)

Introductory course in the design, creation and use of data bases; access, sort and modify data bases; produce reports using BASIC programming; no programming experience necessary; hands-on activities.

Introduction to the IBM-PC: Beginning BASIC Programming (20 hours)

Fundamental concepts of programming languages; write programs using input and output statements, branching statements, iterative statements, single and double subscripted variables, subroutines; error handling, string handling, random-access disk files, sorting and searching data files, and elementary graphics; participants will develop a data base management program as part of the course; hands-on activities.

Introduction to the IBM-PC: Advanced BASIC Programming (20 hours)

Advanced error and string handling, sorting techniques (Shell and Q-Sort), binary search, linked-list data structures, and graphing techniques; students will develop a data base program with a form generator, editor, sorting and searching several fields, numeric and non-numeric sorts and searches of data base; formatting and printing of records; graphing data; hands-on activities.

Introduction to the IBM-PC: Graphics (20 hours)

Introduction to graphics concepts; develop statistical packages to produce bar graphs, pie charts, and line graphs; hands-on activities.

Introduction to the IBM-PC: DOS 2.0/2.1 (8 hours)

Basic concepts of operating systems; format and copy disks; create directories necessary for use of IBM-XT; copy, rename, delete, sort and print files; hands-on activities.

Introduction to the IBM-PC: WordStar (16 hours)

Create, modify and produce letters and reports using Wordstar software. Hands-on activities.

DEGREE LEVEL: Table A. Percent of Students

	Over view	Lotus 1,2,3	Multi mate	dBSE II	DOS 2.0/2.1	Beg. BAS. P.	Adv. BAS.P	Avg % Total	% of Total
PhD	8.7	6.1	5.4	2.9	7.1	11.8	25.0	7.0	
MS MA	13.0	9.8	2.7	17.7	7.1	5.9	-	9.4	
BS BA	23.8	26.8	21.6	32.4	28.8	35.3	25.0	28.1	
AS AA	9.2	11.0	5.4	8.8	25.0	11.8	25.0	11.9	
none	42.2	29.3	54.1	35.3	21.4	35.3	25.0	36.3	
not known	3.2	2.4	10.8	2.9	10.7	-	-	5.0	

Table B. Number of Students

PhD	22	5	2	1	2	2	2	36	9
MS MA	28	8	1	6	2	1	-	46	11
BS BA	48	22	8	11	8	6	2	105	26
AS AA	17	9	2	3	7	2	2	42	10
none	88	24	20	12	6	6	2	158	39
not	6	2	4	1	3	-	-	16	5
TOTAL								403	100

Figure 3

JOB TITLE: Table A. Percent Students

	Over view	Lotus 1,2,3	Multi mate	dBSE II	DOS 2.0/2.1	Beg. BAS. P.	Adv. BAS.P	Avg % Total	% of Total
GEN	23.8	20.7	35.1	20.6	21.4	5.9	-	21.3	
TECH	21.6	13.4	18.9	26.5	39.3	29.4	50.0	24.9	
ASM	24.3	29.3	18.9	8.8	7.1	17.7	50	17.7	
SM	22.7	20.7	24.3	35.3	28.6	41.2	-	28.8	
MS	4.3	-	2.7	5.9	3.6	-	-	2.8	

Table B. Number of Students

GEN	44	17	13	7	6	1	-	88	23.8
TECH	40	11	7	9	11	5	4	87	23.5
ASM	45	24	7	3	2	3	-	84	22.7
SM	42	17	9	12	8	7	4	99	26.7
MS	8	-	1	2	1	-	-	12	3.2
TOTAL								370	100.0

Figure 4

SUPERVISORY RESPONSIBILITY:

Table A: Percent of students

	Over view	Lotus 1,2,3	Multi mate	dBSE II	DOS 2.0/2.1	Beg. BAS. P.	Adv. BAS.P	Avg % Total	% of Total
YES	35.7	28.1	21.6	23.5	25.0	17.7	25.0	25.3	
NO	55.7	54.9	64.9	70.6	67.9	58.8	75.0	62.1	

Table B: Number of students

YES	66	23	8	8	7	3	2	117	
NO	103	45	24	24	19	10	6	231	
TOTAL								348	

Figure 5

Course Data

	Over view	Lotus 1,2,3	Multi mate	dBSE II	DOS 2.0/2.1	Beg. BAS. P.	Adv. BAS.P	TOTAL
Total Number taking class	209	82	37	34	28	17	8	415
Number of Classes	18	8	4	4	3	2	1	40
Average number/ class	12	10	9	8.5	9	8.5	8	10

Figure 6

SUMMARY OF COURSE DATA:

Tables of student data and class statistics are compiled in Figures 3 - 6.

Degree Level:

In Overview and Multimate, there were close to twice as many students without degrees as with BS/BA degrees, the next highest category. In Beginning BASIC Programming, the BS/BA and the "none" categories both had 35%, about three times as many people as in the next highest categories, AS/AA and PhD. In Lotus 1,2,3 and dBASE II, the largest category, students without degrees, was only slightly larger than the next largest category, students with BS/BA degrees. This category was only slightly larger than the AS/AA category. The BS/BA category was 8% smaller than the largest category. Excluding the "unknown" category, the smallest categories were PhD and MS/MA in all the courses.

Job Title:

The Overview course was the only course that showed a fairly even distribution across the various categories (excluding the MS category, which was 4%, or 8 people). In the other courses, except for the Advanced BASIC Programming course, one category came out approximately 10 percentage points higher than the next highest category. In the Lotus 1,2,3 course, ASM was the highest and Gen and SM were approximately 10 percentage points lower. In the Multimate course, the Gen category was the highest and SM was the second highest. In dBASE II, SM was the highest category. The ASM category was significantly smaller than the Gen and Tech categories. The Tech category was the highest in the DOS 2.0/2.1 course. Again, the ASM category was much smaller than the other categories (excluding the MS category). In Beginning BASIC Programming, the SM category was very small. Overall, the SM category was the largest, although it was only 4 percentage points larger than the Tech category and 7 percentage points larger than the Gen category.

Out of 370 responses, only 12 were MS's. Eight out of these 12 were in the Overview course.

Supervisory Responsibility:

Over half the people in every course were without supervisory responsibility. The Overview course had the largest percentage of people with supervisory responsibility. The Beginning BASIC Programming course had the smallest.

Course Data:

Classes in Overview and Lotus 1,2,3 were offered every month, Multimate and PC:DOS 2.0/2.1 every two months, Beginning BASIC Programming twice (four month interval) and Advanced BASIC Programming once.

The Overview course had both the largest number of classes (18) and the largest average class size (12). There were half as many Lotus classes as Overview classes, but the average class size was only slightly smaller. The Advanced BASIC Programming class had the smallest average class size. Two Wordstar classes were cancelled due to insufficient enrollment. One Graphics class was cancelled due to lack of hardware and an incomplete manual.

COURSE EVALUATION:

An evaluation was given to each student at the end of the class, and a summary of comments was made and sent to the instructor. Discussions with the instructor after each class resulted in upgrading the next course. It was felt that immediate student feedback was instrumental in developing the modules of classes to the benefit of all. The following is a summary of the majority of comments for each class.

SUMMARY OF COMMENTS: OVERVIEW

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - to set up files
   - to create memos, charts, reports, etc.
   - will apply basic knowledge to existing systems
   - to know how to use software
   - Lotus 1,2,3 will be used for spreadsheets, budget work, payroll
   - data base management
   - word processing

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - hands-on experience
   - relaxed atmosphere
   - student-teacher interaction
   - instructor's manner and presentation
   - learning about several different programs

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - the course should follow the manual more closely
   - too much info in too little time

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - two 8-hour and one 4-hour sessions
   - a course for true beginners
   - info on other software packages that are available
   - make the course longer
   - send out handouts and literature before the course starts

5. ARE THERE ANY OTHER COURSES YOU WOULD LIKE TO SEE OFFERED?

   - an advanced IBM-PC course
   - BASIC programming
   - graphics

SUMMARY OF COMMENTS: LOTUS 1,2,3

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - data base management
   - spread sheets
   - to create reports, graphs
   - to prepare budget
   - to prepare Form B

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - hands-on training
   - the helpfulness of the instructor

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - the classes were too long
   - introductory material
   - course not long enough

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - have half-day, rather than full-day, sessions
   - a prerequisite so don't have to go over introductory material
   - be able to do graphics

SUMMARY OF COMMENTS: MULTIMATE

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - to create and store letters, memos, and documents
   - to create data files

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - hands-on experience
   - the instructor's attitude and instruction
   - the relaxed, informal atmosphere

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - not enough time for hands-on experience

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - half day, rather than full day, sessions
   - a table of contents and index in the manual
   - make the course a day longer
   - course outline

SUMMARY OF COMMENTS: dBASE II

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - to create and maintain data bases
   - to create inventory, stock, and personnel records

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - hands-on experience
   - programming
   - the relaxed atmosphere of the class
   - the availability and manner of the instructor

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - too little time

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - make the course longer
   - have beginning and advanced courses rather than just one course level--have a prerequisite
   - improve the manual

5. ARE THERE ANY OTHER COURSES YOU WOULD LIKE TO SEE OFFERED?

   - advanced dBase II
   - Savvy

SUMMARY OF COMMENTS: DOS 2.0/2.1

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - will use with the IBM-PC
   - to create reports and records
   - to distinguish between hardware and software problems

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - the hands-on experience
   - the instructor was knowledgeable and enthusiastic

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - not enought time for exercises
   - review of introductory materials

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - make the course longer

5. ARE THERE ANY OTHER COURSES YOU WOULD LIKE TO SEE OFFERED?

   - other IBM-PC courses

SUMMARY OF COMMENTS: BEGINNING BASIC PROGRAMMING

1. HOW WILL YOU APPLY THE MATERIAL FROM THIS COURSE TO YOUR JOB?

   - data base management
   - to create reports
   - to write programs

2. WHAT DID YOU MOST ENJOY ABOUT THE COURSE?

   - the hands-on experience
   - the graphics

3. WHAT DID YOU LEAST ENJOY ABOUT THE COURSE?

   - not enough time

4. WHAT SUGGESTIONS DO YOU HAVE FOR IMPROVEMENT OF THIS COURSE?

   - make the course longer

5. ARE THERE ANY OTHER COURSES YOU WOULD LIKE TO SEE OFFERED?

   - PC graphics

COMPUTER TRAINING FUTURE:

The information age will cause a request for computer training in all areas of the workplace. The need for excellent computer training wil be increasing as public and industrial demands grow. It will be up to the educators in higher learning institutions to take the lead in demanding that students are trained to meet these societal demands. Computer literacy will be essential tomorrow. Students will graduate from high school into the universities with increased computer skills. But also, universities will be faced with the demand to retrain the worker who entered the workforce with no computer background or skills. To meet these requests, it is recommended that programs be developed which will provide a non-threatening learning environment for the novice computer student. Courses with job-relatedness built into them will help encourage and reinforce student learning with the enticement of job advancement or avoidance of a dead-end job. If the job market diminishes the opportunity for job choices, it will become more evident that the worker with additional job skills will be hired more readily into interesting jobs. Computer skills will make the difference between success or mediocrity. It will become more popular to enroll in advanced computer courses to enhance job skills.

Computer training must increase student awareness of the computer work environment. Office and lab design should anticipate computer needs of the future. Courses should include studies in ergonomics (man's relationship with machines). Students should be aware of the societal needs of employees in the workplace, and that work breaks which move the body and provide personal socialization will avoid boredom and lack of attention. A well-planned workspace must be obtained, with proper lighting for non-glare computer work. Furniture (tables and chairs) must be adjustable to the proper height and angle to prevent fatigue and physical discomfort or damage. Proper ventilation and noise control must be considered. Workspace should have the surroundings in colors which are most condusive to work productivity, and which reduce the stress of working with machines. Fitness programs will become a part of employee benefits. They will decrease sick leave and ensure mental health and attitudes. Safety in the workplace should be encouraged by regular safety informational programs for workers unfamiliar with working with machines. In computer classes, safety hazards should be discussed to prevent such accidents as spilled coffee or coke onto computers. This may cause a fire due to the acidic content of these substances, or may cause a short in the electronics.

Future computer training will most likely center around the new software packages which will proliferate in the coming years. Many students will request self-study courses as they feel more confident in using better-written manuals and have more computer experience. Video tapes and CAI courses will become popular as large numbers of students may be instructed using this technology rather than the traditional instructor-conducted class.

Higher educational institutions will become familiar with robotics as this technology increases. Labs will be designed in new circular configurations to accommodate a short robot arm, designed to swing in many directions and "plug" into a stationary unit to perform a function during a robotic process instead of the more time-consuming linear lab configuration. Racks similar to electronic racks will be the standard in the automated lab office, holding the essentials for computer-centered work (printer, plotter, and other data retrieval devices for electronic mail and experimental data).

The computer will enhance our lives of the future, but will also cause an enormous impact upon society. Employees may be isolated from other workers, working at home on a terminal to save hours of commuting time. This will eliminate the stimulus of working and sharing creative ideas and the enthusiasm one derives from interpersonal relationships in the workplace.

University teaching will take on a new meaning when institutions are required to prepare students to meet the demands of technology in our changing world. Man must control the technology — technology must not control mankind. Only through well-educated and skilled citizens will future technology advance mankind. The insight and quality of university teaching hold the KEY to our future.

CONCLUSION:

A successful computer training program for the novice computer student should incorporate hands-on training to instill confidence in the student. Choice of instructor is important for the novice to ensure a non-threatening, positive, learning environment. Courses should be designed with relevance to work situations for self-motivation of the student. It is recommended that courses are located away from the workplace to avoid distractions of work. A half-day format enables the student to complete necessary work requirements. Courses should include aspects of computer safety, and the computer workplace of the future, to raise awareness of the changing workplace due to technology.

REFERENCES:

"Impact on the Computer Revolution", Yourdon Seminar, Chicago, Illinois. March 5 -6, 1984.

Mini/Microcomputer Information Interchange Group Meeting, Aiken, Georgia. October 9 - 11, 1984.

"People, Organizations and Office Technology" Conference, Washington, D.C. December 12 - 13, 1984.

Second International Conference on "Computers in Science", Washington, D.C. October 28 - November 1, 1984.

EDUCATING THE INFORMATION SOCIETY--REVISED

by

G. M. Moulton

Mind Nautilus Industries

Educating the Information Society--Revised

G. M. Moulton

This paper briefly examines five characteristics of the Information Society which have educational significance. These five characteristics raise the issue of whether there is a need to change the educational system in order for it to be more compatible with the educational needs of individuals living in the Information Society. The five characteristics are:

1. a shift from industrial occupations to information occupations (of interest to educators because of the inability to predict the types of jobs and associated skills which will be required)

2. an exponential increase in the amount of information or knowledge created (of interest

to educators for the processing, organization, storage and application problems presented and the speed at which knowledge becomes obsolete)

3. the need for workers to be periodically retrained (of interest to educators because of the need to modify the existing educational system to meet the requirement for additional training)

4. a renewed interest in exploring human potential (of self-explanatory interest to educators)

5. a rapid development of high-technology (of interest to educators because of the application of technology to instruction and learning)

It is assumed the reader has general knowledge of the nature and components of the Information Society.[1] A discussion of the nature of the Information Society is beyond the scope of this paper. The topic is adequately dealt with elsewhere (Masuda, 1980). It is also assumed the reader has general knowledge of the developing technologies (i.e. computers, networks, telecommunications, interactive video, etc.) which have a potential educational application and are the foundation of the Information Society (Singer, 1982). Emphasis is placed on computer technology in this paper.

At the conclusion of this paper answers are proposed to three questions:

1. Will teaching, as we know it, change?
2. Will technology replace traditional in-

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[1] A shift in the main section of the American economy away from "smokestack" manufacturing industries to those based on information, services and new technologies.

struction?

3. What role will the educator play in the Information Society?

Occupation Transition

One of the principal functions of schooling is to prepare students to become responsible members of society. This function is translated to mean: teaching students so they will be able to get a job. In a survey completed in 1982, 86% of the adults surveyed rated preparation for a career as the most important reason for going to college (Solorzano, 1983). It is the educators' hope that the curricula of high school, college and university (drawn from the skills which will be needed in x number and type of occupations) and the present occupation and skill needs of the job market are in harmony. The Information Society impairs the ability to predict the type of jobs which will be needed or available and the related skills which will be required in those jobs (Abbott, 1978).

Table 1 contains a forecast of the United States job market in terms of the jobs which will be significantly effected by robotics and computers and/or created by those technologies in the next twenty years.

TABLE 1: U.S. Job Market Forecast (1990)

Occupation:	Total Number of Jobs: (Million):
Industrial Laser Technicians	2.5
Housing Rehabilitation Technicians	1.75
Robot Production Technicians	1.5
Energy Technicians	1.5
Hazardous Waste Technicians	1.5
Paramedics	1.3
Geriatric Social Workers	1.0
Materials Utilization Technicians	0.5
Fuel cell and battery Technicians	0.25
Bionic appendages Technicians	0.2
Holographic Specialists	0.2
Genetic engineering Technicians	0.15

(Cetron, 1982)

Given the general function of education, the fact that students entering college are seeking a career and the rapidly changing occupational scene there is a major task presented to post-secondary administrators to develop a system which is quickly responsive to supplying individuals qualified to assume futuristic occupations. (Note: Complicating the administrators' task is the finding that by 1990 from 900,000 to 2,000,000 (of 2,444,000) of the high school graduates will not have obtained the essential skills needed to be employed (Forbes, 1982)).

Information Explosion

Hillard described the knowledge explosion as follows:

> "At the rate at which knowledge is growing, by the time the child born today (i.e. 1978) graduates from college, the amount of knowledge in the world will be four times as great. By the time that same child is 50 years old; it will be 32 times as great, and 97% of everything known in the world will have been learned since the time the child was born." (Abbott, 1978, p. 101)

Winner listed four assumptions concerning this information explosion phenomena which have been suggested to necessitate large scale social changes (to include, it would be assumed, the educational system). The four assumptions are:

1. people are bereft of information
2. information is knowledge
3. knowledge is power
4. increasing access to information enhances democracy and equalizes social power (Winner, 1984)

The foundation for these assumptions is that ignorance and forced restrictions on knowledge are somehow to be avoided. Connecting individuals to data banks and communication systems, for example, is judged to be a progressive and advantageous step. Winner's article questions the logic of such solutions to the information explosion. He concluded:

> "Computerization resembles other vast, almost subconscious experiments in modern social and technological history. Following a step-by-step process of improvements in technology, societies create new institutions, new patterns of behavior, new sensibilities, and new contexts for the exercise of power. By calling such changes "revolutionary," people tacitly acknowledge

> that these changes are matters that require reflection; possibly they even require strong public action to ensure that the outcomes are desirable. Yet the occasions in our society for reflection, debate, and public choice are new rare indeed. The important decisions are left in private hands inspired by narrowly focused economic motives. While it is widely recognized that these decisions add up in ways that have profound consequences for our common life, few seem prepared to own up to that fact. Some observers forecast that the computer revolution will be guided by new wonders in artificial intelligence. Its present course is influenced by something much more familiar: the absent mind." (p.96)

One of the focal points in the information explosion is the microcomputer. The extent of this emphasis is such that the term, course and curriculum--computer literacy--has been founded. There have been two types of evaluations on the matter; one side, represented by the Office of Technology Assessment (lack of school funds, limited computer literacy among instructors and students, lack of high quality educational software) and the other side represented by experts who are optimistic (computer literacy as a required course, computer science curricula in high schools, the preference for Pascal, Logo and Basic as computer languages). It appears that to serve the development of technology a case is being made for the modification of existing educational and social structures. As a counterattack to this situation technology should be used to examine how knowledge is acquired, represented, used and controlled.

To phrase it differently: What came first, the information or the explosion? Rather than focusing on the quantitative aspects (which would result in implusive suggestions such as "hooking all students up to data banks") the qualitative aspects should be addressed (Waldrop, 1984). Discussed in this regard emphasis should be focused on the examination of the machine equivalence of human memory, the integration of knowledge into the problem-solving and planning process and the nature of learning. The so-called mind-mirroring programming of computers places emphasis on the process of learning. Theoretically the person who understands how knowledge is assimilated will find it easier to learn new subjects and will, in general, be a better citizen than an individual whose education has been confined to the mastery of particular skills and facts (Watt, 1983). Another researcher has labeled this the process versus the product model--a move from "textbook learning" to "learning while doing". This change of emphasis will have as its focus learning-independent tasks or skills (skills that have to do with learning how to learn and learning more effectively and efficiently and, if appropriate, compensating the individual learner).

Need for Periodic Retraining

The need for individuals to be periodically retrained has become known by the alliterative and education sounding term: life-long learning. Periodically retrained has been translated as four complete "schoolings" in which skilled workers will be totally retrained (Abbott, 1978). The challenge to educators to meet the educational needs of a citizenry requiring life-long learning is an opportunity to assess, in a formative way, the application of technology within existing institutions. Traditional institutions have been seen as either unwilling or perhaps unable to adapt because of a decline in resources (U. S. Congress, Office of Technology Assessment and Waggoner, 1984). There is no lack of technological innovations to fill the void which may be left by traditional institutions. Each new satellite launched brings with it approximately 20 potential "TV" stations and a statement regarding the educational possibilities. The educational applications are largely unexploited. Control Data's Plato system can provide training, for example, in flying a 747. The system has yet to be fully exploited. The interface between video and computer technologies is unexploited. The most significant advances will be made by educators, with and without institutional support, exploiting the technology to serve the life-long learning need.

In spite of the technological skills which supposedly will be needed and the futuristic occupations which individuals will need training in an examination of the particular skills required in the Information Society reveal skills which will not be easily accomplished without traditional educational intervention. For example:

1. comprehensive literacy to include the full range of knowledge, skills, attitudes and communication functions--reading, writing, speaking and listening (see Bennett, 1984)
2. higher order competency than ordinarily associated with basic skills; these include information processing, concept information, problem-solving, conflict management, issue analysis and creative thinking
3. literacy drawn from the full spectrum of communication arts, sciences and technology (Work, 1982)

The expanded need for education (i.e. beyond one diploma) will result in a blurring of the lines between school, home, workplace and community (Singer, 1982 and Atwell, 1984). Technology will be used to increase educator productivity and meet the demand for supplemental education in a cost effective manner (Melmed, 1984). A lack of funds, inadequately trained educators (in terms of familiarity with the developing technology) and lack of leadership will only slow the educational response.

Interest in Human Potential

Through each period in history man has achieved an evolutionary milestone. These milestones have been associated with particular inventions or discoveries. This was graphically illustrated in the movie: 2001 in which the discovery of tool use occupied the initial scenes. Each invention or discovery has enabled man to do more and placed him on the frontier of the next evolutionary step. The automobile, electricity and the telephone (to name but a few) made possible space travel and miniaturization. Technological advances, with specific emphasis on space have recently begun to focus on what can be learned from other beings--witness E.T. and Close Encounters. Developments in space travel with its associated spinoffs in microchip technology have enabled us to conceive of such things as "The Force". In a similar vein recent critiques of the educational system have eluded to the present opportunity to "stretch one's mind" to its full capacity (Davies, 1983 and Passow, 1984). With specific emphasis on microcomputer technology and its associated programs a recommendation is noted to advance beyond simple mastery of basic skills through drill and practice (i.e. the initial use of computer technology and the nature of computer-assisted-instruction) to the development of programs that represent the next logical step in the development of computers (Watt, 1983 and Brown, 1983). With each advancement in technology comes an appreciation and wonder of mankind. The human is smarter and more capable than traditionally acknowledged and the development of technology is the first to mirror our innate abilities. Extrasensory perception, psychic perception, alter-states processing are being integrated with the higher intellectual skills of creativity, deductive and inductive logic and are being suggested as valid and relevant curriculum areas

(Galyean, 1983 and Dodd, 1984).

We are getting smarter and we are making smarter machines. These skills and abilities must be integrated into the curriculum. The result of such training and education may revolutionize education and learning practice (Straham, 1983).

Development of Technology

Microcomputer technology is one of the "hot" educational topics of the day. The educational application of this technology has not gone unnoticed. Well over 5 million personal computers have found their way into this nation's homes with 46% of the purchasers reporting they purchased the machine with the hope of using it in an educational application. An additional 325,000 microcomputers are in classrooms across the United States. The technology which is developing so rapidly is overtaking traditional educational caution--estimates for 1987 indicate that 1.2 million computers will be in classrooms across the U.S. and an estimated 600 million dollars will be spent on educational software. Technological developments are placing us on the brink of a quantum leap into the future. Is the arrival of the computer in the classroom a marketing ploy or does microcomputer technology hold educational promise? The jury is still out with reference to this technological marvel. In spite of this increase in available technology and the effect that it will have on occupations the educational: "What do we want to do with it?" has not been addressed (Bernstein, 1983). In an extensive examination of this nation's schools Goodlad found routine inconsistency between practice and ideal (computer-assisted-instruction perhaps could be considered an ideal) (Goodlad, 1984). The questions being forwarded and addressed are still very basic ones, for example, will this technology be used for teacher productivity or human potential expansion? The overall evaluation is that the structure of education has not been changed consistent with technological development. They are perhaps incompatible in their present form (Griffen, 1983 and Masterton, 1984).

Discussion

There are four conclusions which can be made from the information presented in this paper. They are:

1. educators will lose the ability to project the occupations for which they will be preparing students in the future and they will be responsible, either directly or indirectly, for periodic retraining

2. educators have at least as significant a role (and school a function) in the Information Society as they had in the Industrial Society, in particular with reference to an extensive examination of the limits of human potential; at the very least educators will be the professionals responsible for insuring the appropriate use of technology (i.e. that technology will be used at its highest level)

3. opportunities for the educational entrepreneur exist

4. leadership in educating the Information Society will rest with high school, college and university faculties

Briefly; the major reason for the attention focused on education (example, the National Commission on Excellence in Education) has come about as a result of the rapidity with which occupations and industries are being changed. For example, the need for engineers is reflected in faculty requirements down to the high school level and curricula needs down to the elementary school level. The response of the educational community must be comparable to the way in which a manufacturer meets a demand for product. The response should also go beyond the quantitative--more homework, academic requirements, etc.. As opposed to focusing on curriculum changes or modification of programs attention should be on process and expansion of the learning and intellectual skills required. This can be done if preparation through the basic skill area has been adequate and multiple and alternative learning opportunities are present. A change in the structure of education may be necessary to accomplish this goal.

In the area of entrepreneurship some preliminary advances have been made--educational systems as high-technology business and alternative degree programs. Educators will continue to look at educational needs and existing technology and put together educational programs which are educationally relevant.

There is indeed a negative and a positive side to all of this information. The characteristics of the Information Society could as easily be used to justify a total swing to "back to basics" in the traditional sense or the justification of the cosmopolitan-educated individual (one with little knowledge in all subjects and a well developed ability to quickly respond to new situations by plugging himself/herself into some kind of knowledge factory. The common factor appears to be total development of the learning abilities in all areas of human intelligence. Technology in hand has made this possible and will enable the next evolutionary step to be taken.

Proposed Answers

Question 1: Will teaching evolve? No. Human learning potential will evolve and bring with it curricula and methodology changes.

Question 2: Will technology replace traditional methodology? No. Traditional methodology will represent a smaller percentage of the manner in which knowledge or an education is acquired.

Question 3: What is the role for traditional education? The total development of human potential; the total development of the learner.

Abbott, W. 1978. Work in the Year 2001. Washington: World Future Society.

Atwell, C. 1984. Critics of life-long learning: a reasoned response. Community Services Catalyst. 14(2): 5-8

Bennett, W. 1984. College grads "shortchanged in humanities.. The Valley Times(AP). November 26, 1984

Berstein, H. T. 1983. The information society: byting the hand that feeds you. Phi Delta Kappan. 65(2): 108-109

Brown, J. S. 1983. Process Versus Product: A Perspective on Tools for Communal and Informal Electronic Learning. Report from the Learning Lab: Education in the Electronic Age; Educational Broadcasting Corporation.

Cetron, M. 1982. Careers with a future: where jobs will be in the 1990s. The Futurist. XVI(3):11-19

Davies, G. K. and Slevin, K. F. 1983. Babel or opportunity? recent reports on education. College Board Review. 130: 18-21, 37

Dodd, A. 1984. A new design for public education. Phi Delta Kappan. 65(10):685-687

Forbes, R. H. 1982. The information society. The School Administrator. 39(4)

Galyean, B. C. 1983. Expanding human intelligence. The Futurist. XVII(5):66-69

Goodlad, J. 1984. Interview with John Goodlad. Instructor. XCIII(5):56-58.

Griffen, W. H. 1983. Can educational technology have any significant impact on education. Technological Horizons in Education. 11(3):96-99

Masterton, P. 1984. A futurist looks at edtech or wheel reinventing reconsidered. Technological Horizons in Education. 11(4):143-146

Masuda, Y. 1980. The Information Society as Post-Industrial Society. Tokyo:Institute for the Information Society.

Melmed, A. S. 1984. Educational productivity, the teacher and technology. *Technological Horizons in Education*. 11(6):78-82

Office of Technology Assessment, U. S. Congress 1982. *Information Technology and Its Impact on American Education*. Washington:U. S. Government Printing Office

Passow, A. H. 1984. Tackling the reform reports of the 1980s. *Phi Delta Kappan*. 65(10):674-683

Singer, N. (Ed.) 1982. *Communications Technologies: Their Effect on Adult, Career, and Vocational Education*. Columbus, Ohio:ERIC Clearinghouse on Adult, Career and Vocational Education

Solorzano, G. 1983. Liberal arts colleges bow to the future. *U. S. News and World Report*. 94(20):67

Straham, D. B. 1983. The impact of brain research on the education profession: agents of change. *Journal of Children in Contemporary Society*. 16(1-2):219-233

Waggoner, M. 1984. The new technologies versus the lecture tradition in higher education. *Educational Technology*. 24(3):7-13

Watt, D. Mind-mirroring software. *Popular Computing*. October, 1983:65-68

Waldrop, M. M. 1984. The necessity of knowledge. *Science*. 223(4642):1279-1282

Winner, L. 1984. Mythinformation in the high-tech era. *IEEE Spectrum*. June:90-96

Work, W. 1982. Communication education for the twenty-first century. *Communication Quarterly*. 30(4):265-269

ARTIFICIAL INTELLIGENCE AND THE UNIVERSITY COVENANT: SPECULATIONS ABOUT THE IMPACT OF TECHNOLOGY ON THE PURPOSES OF EDUCATION

by

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ARTIFICIAL INTELLIGENCE AND THE UNIVERSITY COVENANT: SPECULATIONS ABOUT THE IMPACT OF TECHNOLOGY ON THE PURPOSES OF EDUCATION

by Eugenie Potter

> It is difficult to predict,
> especially the future.
> _Feigenbaum and McCorduck

My paper differs perhaps from many of the others at this conference in that I have no new and exciting teaching techniques to share with you. Nor do I have any research results that will demonstrate the efficacy of one college curriculum over another in preparing our students for the so-called "real world." Rather I should like to provoke your thoughts about the reasons that you and I and all of us in education do what it is we do. By the title of my paper, it might appear that I am talking about something called "the future," but in fact I am talking about today as much as -- perhaps more than -- tomorrow.

If we were to review the history of education, characterizing its functions as we did so, we would find that education generally has served three primary purposes:

1. the preservation and transmission of the culture -- this purpose pervades all education but is most clearly seen in homogeneous societies. Indeed, one of the principal problems of tribal groups, such as Native Americans in this country, is the struggle to hold on to their inherited culture while at the

same time learning the skills necessary to compete successfully outside their groups (1);

2. the preparation of the young for economically productive lives -- this purpose forms the backbone of formal education in modern industrialized countries. In their book Schooling in Capitalist America, Bowles and Gintis stated that American education is designed to inculcate from the earliest grades onward the norms and values of the workplace: promptness, discipline, respect for authority, etc. (2);
3. the development of individual intellectual and social capabilities -- we tend to think of this purpose as a distinctively modern one, but it can be found repeatedly in the history of education: in the schools of Periclean Athens, in those of the Renaissance humanists, and in those of the great 17th century reformer Jean Comenius to cite just a few examples (3).

To these three purposes we can add a fourth fulfilled by colleges and universities: the generation of new knowledge through academic research. Those educational purposes might seem to be "eternal" -- they seem to have been around forever and seem likely to continue as long as the human race does.

I should like to take a contrary view, however, and say that the computer-related technology now available, to say nothing of that which will come into being with the next generation or two of computers, has the potential for challenging those fundamental purposes of education and with it, our fundamental assumptions about who we are as human beings.

To begin to understand the potential of that impact, I should like to ask you to indulge in a sweet fantasy. Try to imagine for a moment that you suddenly became independently wealthy. Pick any sum -- $10,000, 100 million, whatever -- that, if you had it, would release you from the necessity of work, that would purchase all your heart's desires, that would enable you to do anything you wanted. What, then, would you do with your life?

Seventy or eighty years is a long time to fill with activity. After the immediate imperatives -- the mortgage, the kids' dental work, a decent amount in a retirement account -- had been taken care of, after the desire for material goods had been sated, after trips to far-away, exotic places had renewed the value of home and friends, what then? What would give your life meaning?

For most of us the question may seem silly, a never-to-be-had dream. But it is one that may face our children, or theirs, and through them, the structures and institutions of society that today we take for granted. The technology now among us holds the potential for transforming our society from one in which an individual's value is measured by the work he or she does to one that is very nearly "workless." Let us examine some evidence for that statement.

In a November 1982, issue of Forbes Magazine, James Cook wrote that almost all the tools invented by humankind since its primitive beginning had been designed to relieve the work of the back and the hand; computer-related technology had been designed to relieve the work of the mind (4). Workers displaced by industrial technology in the 19th and 20th centuries sometimes reacted violently, but ultimately the technology led to new industries and thus to new jobs for them.

Many forecasters think the same will hold true for the new technology. Others do not agree. The Department of Labor estimates that technology will have cost the U.S. three million jobs between 1980 and 1990, and at least seven million by the year 2000 (4). These are jobs at the structural level, that is, jobs of such a type that the displaced workers cannot find similar employment by moving to another company or to another area of the country. They must learn new skills. For many it is too late, they are at an age when involuntary retirement is the best option (4).

Those who do avail themselves of retraining often -- perhaps usually -- find themselves in low-paying, dull, repetitive jobs that are themselves subject to obsolescence through the use of such technology as robotics (5). But, you may argue, all that is part of the change from an industrial to a service economy. The new jobs are in human, not machine-oriented work places. Indeed, that is true.

Let us look a little more closely, however, at the impact of technology on the service sector. In general the service economy is defined as the occupations that provide services rather than goods, although the handling of goods may be part of the service. Thus service contrasts with agricultural production, extractive processes (mining and petroleum, for example) and manufacturing processes.

We in education share the service sector with those in health care, in government and other public services, in banking and related industries, and in wholesale and retail trade. Ours is the sector designated "white collar." We have more trained technicians, more managers, higher levels of education, and higher individual incomes (6), although these attributes depend, of course, on where in a broad spectrum an individual job occurs.

For us the computer is simply a tool to make our working life easier and more productive. But is it just that?

In a recent article by the Associated Press, bankers were said to be expressing concern about some unforeseen consequences of computer use by real estate offices. As it happens, individual real estate offices can now have, through computer/telephone links, the latest comparative information on mortgage rates, points, funding options, and all of the other financial paraphernalia that goes into a competitive "package" for their clients. Furthermore, through that same technology, the clients' credit reliability can be determined, the forms for processing the transaction can be generated, and the transaction itself can be made -- all in a matter of an hour or so. The client need not leave the comfortable chair in the real estate office (7).

The banker, whose profession as middleman in such transactions dates at least from the Renaissance, is being replaced by a machine that, even in a highly sophisticated version, today costs less than $5000. Similar tales can be told about stock brokerage, car sales, tax and accounting firms, and other occupations that just a few years ago were thought to be immune to the displacement effects of technology.

Ah, you may object, but those are generalized occupations. The machines can't replace specialists, people with high educational levels in highly specific areas such as engineering, medicine and teaching.

How accurate is that objection? Let us consider some of the potential of artificial intelligence.

Artificial intelligence is that area of computer-based research that attempts to "mak[e] machines do things that would require intelligence if done by [humans]" (8). The field is broad, taking in all three domains in Bloom's taxonomy of learning: the psycho-motor, the cognitive, and the affective.

Most commercial applications of artificial intelligence are in the areas of robotics and expert systems. Robotics is understood, I think, at least in a general way. It may be useful, however, to describe expert systems.

Expert systems are computer programs that contain a large body of information about a specific subject, usually called a "knowledge base." They also contain algorithms, or rules, that operate on the knowledge base to produce a result. The various types of expert systems differ in many ways, including the structure of the knowledge base, the types of algorithms used, the bases for process and product decisions, and, of course, in the level of complexity and sophistication.

Whether simple or complex, however, they have in common two things: first, the knowledge bases and algorithms represent the pooled knowledge and decision rules of many experts in the field, and, second, they have the ability to do what we would customarily term an intelligent process: take information, apply rules to it, make inferences, and draw conclusions (9).

Let me illustrate some applications of expert systems. The field of geologic exploration is highly expensive not only because of the equipment used and the cost of purchasing mineral rights in areas that may or may not yield returns, but also because mining and petroleum firms must employ the expertise of highly educated (therefore expensive) staff geologists.

A few years ago SRI International, a research firm in Menlo Park, CA, in cooperation with geologists from the U.S. Geological Survey, developed an expert system called PROSPECTOR. The system's knowledge base contained general information about geology and mineralogy and, in addition, could be given information about geologic conditions of specific regions.

The system was purchased by a large company. It paid itself off almost immediately by predicting a find in an area where company experts had not supposed there would be one. In fact the company had for years been dumping tailings from a nearby mine on the site of the deposit predicted by the PROSPECTOR program (10).

Another example -- CADUSEUS is a medical program that can diagnose over 2800 diseases while taking into consideration such factors as personal habits, environmental exposure, and travel (11). Although it is designed for use in large clinics and in teaching hospitals to both teach and test the knowledge of medical students, it can conceivably be used as well in the general medical field to assist the diagnoses of practicing physicians or in remote locations to aid nurse practitioners, paramedics and others without broad medical training. It is also conceivable that in the future we as patients may be able through home computers and telephone lines to gain access to a similar program, describe our symptoms, and receive a diagnosis and prescription -- along with a bill for services, of course!

The purpose of these illustrations is not to fill you with awe for the prospective power of technology -- although there is reason aplenty for awe -- but rather it is to demonstrate that there are few occupations we can consider that are not likely to feel the effect of the machines that are designed to relieve the work of the mind as well as that of the hand and the back.

There are some who are concerned about this prospect on economic grounds: if we are bereft of the means for earning an income, how then will we as individuals and the economy in general be sustained? Nobel laureate economist, Wassily Leontiev, stated the matter this way:

> Adam and Eve enjoyed, before they were expelled from Paradise, a high standard of living without working. After their expulsion they and their successors were condemned to eke out a miserable existence working from dawn to dusk. The history of technological progress over the past 200 years is essentially the story of the human species working its way slowly and steadily back into Paradise. What would happen, however,if we suddenly found ourselves in it? With all goods and services provided without work, no one would be gainfully employed. Being unemployed means receiving no wages. As a result, until appropriate new income policies were formulated to fit the changed technological conditions, everyone would starve in Paradise (12).

Leontiev, being a humanist and a good teacher as well as a good theorist, went on to allay the fear of starvation by recommending some alternative means for distributing income. My concern today, however, is not with the direct economic implications of technological change, but is rather with its effects on the purposes of education.

Let me state here some fundamental and optimistic assumptions:

1. that the human race will continue; that is, that the political and ideological differences that seem to be part of our human inheritance will not have led us to use nuclear force as a solution;
2. that the economic problems of transition foreseen by Leontiev and others will have been found and that we will not be starving in Paradise;
3. that the capability of thinking machines foreshadowed by the kinds of expert systems I have described will have been realized and turned to good purpose.

Let use turn now to the implications of technology for the purposes of education. If we look at the three fundamental purposes, that is, the preparation for work, the preservation and transmission of the culture, and the development of individual potential, we can readily see that technology may have a severe impact on the preparationist purpose. In fact a number of national reports in recent years have stated that narrow vocational training is inappropriate in today's rapidly changing employment world (13).

Many jobs for which high school graduates, two-year college students and even baccalaureate degree holders have prepared themselves maybe obsolete within a few years after the new graduate has begun working (14). Continuous vocational retraining may be a better way to state this educational purpose today. We have seen, too, that even those with advanced degrees cannot be assured that their specialized knowledge cannot be codified and made accessible -- relatively inexpensively -- through expert systems.

That is today's reality. What of tomorrow? Artificially intelligent machines and their less intelligent cohorts, the robots, do not require long years of training to acquire their skills. Nor do they require inculcation in the norms and values of the workplace. What happens, then, to the preparationist purpose of education?

Teachers of the humanities, the classics, the arts may find their hearts lifting with joy -- the post-technological era will be another Golden Age of attention to what John Dewey called "the inherited riches of the race" (15).

Let me sprinkle a little cold water on that idea by suggesting two things: first, the current resurgence of interest in general education has stemmed, at least in part, from the advocates' insistence that the kind of skills learned through general education carry into the workplace and , in fact, enhance the graduates' ability to succeed in a career (16); second, perhaps one reason that the humanities, the classics, and the arts have the vividness they do for us today is that they stand in contrast to the often pedestrian workaday world in which most of us live.

What may happen to that vividness when there is not that contrast? In this country we have not had a cultural tradition of a leisured aristocracy in whom an appreciation of "the finer things in life" is passed from generation to generation. We have chosen instead to pluralize appreciation. Will it be possible in a leisure society not only to sustain that approach but to make it a cornerstone of cultural tradition, as well?

Let me treat another aspect of the cultural transmission purpose of education. We sometimes assume that Culture -- with a capital "C" -- is what education preserves and transmits. Yet Bowles and Gintis, whom I cited earlier, stated that education inculcates the "norms and values" of the workplace. Norms and values form the core of almost any definition of "culture" that one might pluck from a social science textbook.

In our society norms and values are bound like Siamese twins to the work ethic. Therefore, to suggest today that a double digit unemployment rate may be the harbinger of the new society and that income will have to be redistributed according to a new, emerging workless ethic is to do violence to our culture's traditional measures of individual worth. What cultural tradition, then are we to preserve and transmit as fulfillment of our educational purpose?

If the post-technological society deprives us of the work preparationist purpose and perhaps as well of the purpose to preserve and transmit the culture, surely that third fundamental purpose of developing individual potential must hold true. After all, in a workless society what is left _except_ individual development.

But there is a problem here as well. Individual potential exists in contrast to some standard, often historical. Individual potential also develops within a context. We can recognize outstanding achievement in today's world through comparison and contrast with our own cultural context. It is impossible to imagine how individual potential and individual excellence might be defined in the post-technological future. The question before us today, however, is whether formal education is likely to be a necessary part of that developmental process.

This apocalyptic litany may lead you to conclude either that we should take immediate Luddite action against the advance of technology or else that we, or perhaps our children, should declare education dead and bury it -- with all suitable sentiments, naturally. I have been deliberately provocative because, of course, I should like to suggest another alternative. Before I do, however, perhaps I should extend some reassurance.

A recent gathering of artificial intelligence experts, reporting to the Congressional Office of Technology Assessment, stated their opinion that a true leisure society might never occur, but that if it did, it is at least 75 to 100 years in the future. They also said, however, that the interaction between technology and employment will be a critical area for social policy from now until well into the next century (17).

That means that for those of us in education it is not too soon to begin thinking about the purposes of education in a post-technological society. I would submit, however, that "the future" is the wrong time frame. Educational philosopher, T. Frank Saunders, has remarked, "The future is a remarkable kind of value imperative whose progeny is the present"(18).

If we peer beneath the purposes of education that I have outlined today, we can perhaps discern a common ground: each is concerned in its own way with stating what it is that we mean by "human." The birds and the beasts sustain themselves but don't labor to increase their wealth. Neither, however, do they transmit a cultural heritage, enriching it creatively in each succeeding generation. They are truly existential beings.

Ours is a different covenant. We are neither existential beast nor machine.

If we fix solely upon the economic prospects of artificially intelligent machines, we overlook, I think, the opportunity that the presence of those machines affords us to examine deeply the ethical and aesthetic values by which we define our humanness.

Artificial intelligence has the potential for stripping from us so many of the comfortable, convenient ways we now answer the questions "Who are you?" and "What are you?" It challenges us to define ourselves in other than existential terms, in other than work-related terms, in other than cognitive capability terms, as part of -- but something more than -- inheritors of a cultural tradition.

In the end it does not really matter whether artificially intelligent machines do all the work of the world. That is a problem of condition, not essence. Nor does it matter if the machines eventually are programmed to have feelings, mental states, values. We already have those. What matters is what we choose to do with them.

We began this discourse with a "million dollar question." Those of you who answered silently, "I'd do exactly what I'm doing now," are the fortunate among us. I would suggest that education's million dollar question ought to have something of the same answer.

Philosopher F.E. Sparshott, remarking on the applicability of philosophical inquiry to everyday life, said:

> Perhaps in the end all philosophy is a philosophy of man; but it is of ethics and aesthetics, which avowedly deal with what man makes of himself, of his

> world and of his relations with his fellows, that this is most obviously true (19).

If we choose today to extrapolate the traditional purposes of education into the post-technological future, we may find that our enterprise has no reason for being. If, however, we choose to make education an aesthetic experience by developing in ourselves and our students the joy of inquiry, and, further, if we shape that inquiry around the ethical problems of sifting and sorting and deciding what it is that we are to make of ourselves and of our world, then we have made a covenant that transcends mere technological change. It is a covenant that joins the present with our heritage and our future. It makes of education that process in which values and commitments come together to define what it is we most truly mean by "human."

REFERENCES

1. Estelle Fuchs and Robert Havighurst. TO LIVE ON THIS EARTH: AMERICAN INDIAN EDUCATION. Garden City, NY: Doubleday, 1972, pp. 468-478.
2. Samuel Bowles and Herbert Gintis. SCHOOLING IN CAPITALIST AMERICA. New York: Basic Books, 1976, pp.31-32.
3. Jean Piaget (Ed.) JOHN AMOS COMENIUS ON EDUCATION. New York: Teachers College Press, Columbia University, 1967.
4. James Cook. "The Molting of America," FORBES MAGAZINE. 130:11 (November 22, 1982) 161-167.
5. Henry Levin and Russell Rumberger. "The Low-Skilled Future of High Tech," TECHNOLOGY REVIEW. (August/September 1983) 18-21.

6. Wassily Leontiev. "The Input-Output Structure of the United States Economy," SCIENTIFIC AMERICAN. 247:3 (September 1980).

7. Associated Press. "Computers Take over Big Chore for Home Buyer," TUCSON CITIZEN. November 26, 1984, p.9A

8. Marvin Minsky (Ed.). SEMANTIC INFORMATION PROCESSING. CAMBRIDGE, MA: MIT Press, 1968, p.9.

9. J.N. Shurkin. "Expert Systems: the Practical Face of Artificial Intelligence," TECHNOLOGY REVIEW. 86 (November/December 1983) 72-78.

10. Edward Feigenbaum and Pamela McCorduck. THE FIFTH GENERATION. Reading, MA: Addison-Wesley Publishing Co., 1983, p.74.

11. ------ "A Major Breakthrough in Artificial Intelligence," MICRO MD NEWSLETTER. (November 1984). Bryn Mawr, PA: NewsNet Online Information Service, p.1.

12. Wassily Leontiev. "The Distribution of Work and Income," SCIENTIFIC AMERICAN. 249:3 (September 1982) 188-204.

13. Robert J. Nash and Edward R. Ducharme. "'Where There is no Vision, the People Perish': A Nation at Risk," JOURNAL OF TEACHER EDUCATION. 34:4 (July/August 1983) 38-46.

14. Fred Best. "Technology and the Changing World of Work," THE FUTURIST. 18:2 (April 1984) 61-66.

15. John Dewey. "My Pedagogic Creed," JOHN DEWEY: THE EARLY WORKS, 1882-1898, v.5:1895-1898. Carbondale: Southern Illinois University Press, 1972, p.86.

16. Michael W. Apple. "Curriculum in the Year 2000: Tensions and Possibilities," PHI DELTA KAPPAN. 64:5 (January 1983) 321-326.

17. ------ "Strong or Weak AI?" IIA FRIDAY MEMO. (November 30, 1984) Bryn Mawr, PA: NewsNet Online Information Service, p.1.

18. T. Frank Saunders. "Man's Intelligent Future," PROCEEDINGS OF THE FAR WESTERN PHILOSOPHY OF EDUCATION CONFERENCE, 1972, p.123.

19. F.E. Sparshott. THE STRUCTURE OF AESTHETICS. Toronto, Canada: University of Toronto Press, 1963, p.435.

TEACHING, TECHNOLOGY, AND THE FUTURE

by

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TEACHING, TECHNOLOGY, AND THE FUTURE

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Teaching

The advent of the 1980's has brought the issues of effective teaching to the foreground. Falling enrollments in higher education and the conservative mood of legislators have seriously affected the budgets of educational institutions. Although good teachers have always been in demand, recently, increased attention has been placed on teaching effectiveness. Contemporary conditions, such as civil rights suits resulting from performance evaluations or the misuse of tenure as a means of employment security rather than as an environment for seeking and teaching the truth, have caused the professional teacher and administrator to explore measurable factors associated with teaching effectiveness.

Attempts to operationally define good teaching or to characterize an effective teacher have produced varying and often vague results. Rouche and Watkins while discussing "great" teaching in a community college setting cite Hildegrand and Wilson who suggest that the instructor should go beyond simply delivering facts, patterns or themes, or implications or concepts to support facts. They emphasize the instructor should be clear, well organized and effectively use examples and appropriate analogies. Further, the instructor must be able to effectively manage groups - control, pace, and stimulate effective interaction[1]. According to Hildegrand and Wilson genuine concern for learners as individuals is an essential part of relevant pedagogy and the teacher's eager interest for teaching his subject is absolutely necessary! Rouche and Watkins also cite Schneider et. al. in their study which describes effective teachers of adults as "those who successfully perform a balancing act. They balance classroom teaching with mentoring or advising on a one-to-one basis; student centeredness with highly directive and prescriptive behavior; a clear focus on task with creative, flexible options for student participation".[2] They go on to say that "excellent faculty are those who engage students in their own learning while demanding excellence."[3]

"Good teaching", according to Lewis, has been defined as "what the teacher does to produce inspired pupils, excited pupils, interested pupils, creative pupils, pupils who are good citizens, who can read, do arithmetic problems and write grammatical English essays." Lewis goes on to define good teaching as "developing critical thinking, subject matter mastery, ideals, love of freedom, respect for law and order, universal brotherhood, various attributes of character, a love of learning and a devotion to the arts."[4]

Roush reviewed the literature on university teaching from the late 1960's to 1983. He identified factors critical to college teaching success which included:

"A. Excellent knowledge of subject matter.
B. Dynamic classroom relationships and ability to evoke meaningful classroom response.
C. Ability to involve students in their own education.
D. Enthusiasm for subject and teaching.
E. Empathetic understanding of the student."[5]

Additionally he identifies fairness in assessment and teacher impact on students outside the classroom as critical in effective teaching. Roush also believes teachers of distinction and imagination can develop creativity and values in teaching that are significant in teaching effectiveness.

Williams present an interesting treatise on "How to Teach.... Badly". He said that beyond the freshmen year students have more experience, but not necessarily better teachers. Reasons for the lack of excellence in teaching are principally five, "First, it is rare to find any teacher who has not succumbed ...to the pressures of the system in the matter of examinations, grades, and credits. The ideal he holds up to himself is to teach a good stiff course.... A second reason why teachers of upper classes are seldom good teachers....is that they somehow get the notion that 'upholding the standards of the university' means essentially giving many low grades. A third reason...is the idea that learning is unpleasant work. A fourth reason for bad teaching is mere negligence and indifference on the part of the professor. A final reason..... is the lack of a personality that can put itself in rapport with many types of student personalities, understand how to interest and stimulate young minds, and perceive the many facets that many minds may discover in most types of human knowledge."[6]

The attempts at accurately defining excellence in teaching goes on and on and the need for a measureable, clear, operational definition still exists. For purposes of this paper, the competencies characteristic of "good" teachers include: excellent knowledge of subject area; good organization; enthusiasm for subject and teaching; empathy toward students; good communications; fairness and impartiality; adaptablity to new techniques and knowledge; development of creative and inquiring minds; a sense of humor.

One of the many ways the educator can attempt to improve his effectiveness is through the use of "high tech" aids. Historically, the classroom lecture has been the dominant means of educational delivery. Yet today the teacher is confronted with peers, administrators, and salesmen encouraging the use of various technological schemes to improve teaching effectiveness.

Technologies

Twenty years ago terms such as computer assisted/managed instruction, audio tape cassettes, microcomputer-based courses, video discs, push button materials and geostationary satellites were uncommon or did not exist. The use of these technologies has in turn helped to introduce new concepts such as value added instruction and distance learning.

Technological Educational Methods-Will They Help?

The wise use of technology such as audio-visual aids or computers in teaching can create excitement and enthusiasm in the educational environment. Computers, for example, can improve efficiency in storing and retrieving data and can be a great source of pleasure while acquiring new knowledge. High tech equipment in teaching should be viewed as an additional resource to improve teaching.

This technology can greatly assist students who wish to learn on their own. While discussing newer trends in teaching, Boaz describes self-paced instruction as "a departure from traditional regular class meetings. Self-paced instruction and the use of television programming to instruct students are alternative teaching methods."[7] Through technology, students who live great distances from campus can still be actively involved in curricular activities and, at the same time, influential experts can share their knowledge on campus through telecommunications and video.

Senese believes, "The computer, as well as other technological innovations, can provide us with a means of offering improved educational opportunities in a cost effective manner."[8] Kemp agrees and suggests, "Based on learning theory and communications research, the technology of instruction provides the means whereby learning can be effective and efficient."[9] He emphasizes the value of audio visual materials in learning by adding that "they make education more productive, individual, immediate, equal for learners and give instruction a more scientific base."[10] The same advantages can probably be cited for other high tech teaching technologies.

Denton et. al., examined instructional strategies while exploring the effectiveness of two-way television. Based on data collected from 32 presentations by 7 professors in the College of Medicine at Texas A&M University over 9 months they concluded that "...achievement was at least as high on materials presented over two-way television as they were on materials presented with the professor present in the classroom."[11]

If a teacher is effective, the appropriate use of a high tech teaching mechanism will increase teaching effectiveness. It will do so not necessarily because of the high tech equipment, but because the effective educator has the intuitive - if not the technical - ability to select and use technological equipment to enhance his skills. Technology should be an additional tool in his teaching arsenal; a tool which he will use to create situations in which students will learn more effectively.

Limitations To The Use Of High Tech Technologies

It is highly unlikely that all the technologies produced by high tech companies can do much to improve teaching effectiveness if an instructor lacks teaching ability. Technological teaching methods cannot be used as a prop to improve poor teaching. Likewise, they can do little to improve the skill of a poor communicator, or the teacher with little enthusiasm, organization or counseling ability.

Herschbach identifies some areas of concern in the use of educational technology. He says: "1. Technology producers and the public are leading the movement for educational technology, but no coherent policy exists... 2. Educational technology, particularly software, is not at the present time cost effective. [This is not in exact agreement with Senese!] 3. Educational technology is not necessarily more effective than conventional educational techniques. 4. Educational technology is used more for 'value added' instruction that has a positive effect on students, although it is difficult to measure."[12] Sardello in describing the technological threat to education suggests, "Microcomputers in the classroom pose a technological threat to learning because they transform education into psychology."[13] In the same manner, Simpson warns that "computers can be a valuable instructional device when they are used to support teachers rather than replace them."[14]

Knapper while discussing barriers to adoption of instructional technology states, "...research evidence for the effectiveness of technology based instruction compared to traditional teaching methods is equivocal" and he goes on to say, "Furthermore, teachers may be understandably reluctant to relinquish the minute-by minute control over the learning process to a technology based system that they barely understand."[15]

Non-acceptance of technology in adult education may also be a problem as Knapper notes, "Learners - particularly the increasing population of mature students - often place a high value on human and social contacts and may resist teaching that is controlled primarily by a machine, however ingeniously it is programmed."[16]

The Professor

Teachers have a habit of teaching the way they have been taught. Those who have not been exposed to curricula which improve teaching communication skills lack appreciation for different or improved teaching methods. It is doubtful, for example, that the curriculum required for a Ph.D. in biology would require any courses in teaching methods or technological teaching methods. Furthermore, the likelihood of receiving effective teaching training through such biological courses is marginal. Having been "awarded" a doctorate upon graduation and told by the commencement speaker et. al., of his academic brilliance, it is doubtful if the graduate would be receptive to the idea that his teaching could be improved. Certainly it would not seem to him that any of his colleagues (much less administrators) could improve his teaching.

Change, however, is all around the teacher. As decreased budgets, declining enrollments, and student/teacher evaluations begin to exert pressure, his boss will begin urging him to improve his teaching skills. While the teacher may have experience, experience alone will not suffice.

All this change will not be easy for the instructor or the organization. While discussing such things, Rogers cites Bagehot as he says, "One of the greatest pains to human nature is the pain of a new idea. It...makes you think that after all, your favorite notions may be wrong, your firmest beliefs ill-founded... Naturally, therefore, common men hate a new idea, and are disposed more or less, to ill-treat the original man who brings it."[17] Frye adds another dimension to this problem as he states, "Adoption of new technologies will be delayed because most schools which cannot adapt to the new technologies may face aggressive competition for students from those who can."[18] He also notes, "Faculty needs reassurance that improving productivity through new learning systems will not result in a loss of status or benefits."[19] He then adds,..."faculty should understand that breaking the constraints of classroom instruction can lead to greater rewards and success. In new systems the faculty member is often more of a learning manager than a classroom teacher."[20]

Cross espoused the proposition that "college teaching can be improved... because improvement is desperately needed and...we do know how to do it... but...[we are] less sanguine that it will be improved." In her study of 706 responses from a randomly selected sample of roughly half of the faculty on three Nebraska campuses, Cross concluded that "[the professors] are not well informed about knowledge related to the evaluation of teaching, student learning, or instructional innovation, and worse yet, they seem reluctant to learn."[21]

Weaver suggests, however, "Good teachers are made, not born..."[22] Every college professor has the professional obligation to constantly examine technological education methods, try them and adopt those which improve his/her effectiveness as a teacher. To do anything less short changes his students, degrades him professionally and leaves him stale as a teacher. It is professionally immoral for a teacher to use the same notes, or organizational and teaching methods he was using five years ago, much less twenty years ago.

The Administrative Responsibility

The responsibility of the organization in such a situation is to provide opportunities, encouragement and incentives. If administrators are sincere about their wish to improve teaching, then it is necessary that favorable situations be created where professional growth can be developed. In turn, if administrative rhetoric declares that rewards will follow improved teaching, then ensuing behavior must be consistent with what is said.

Opportunity must also include appropriate supervisory behavior. Professors must have opportunities to see, try, fail and succeed in a positive atmosphere. Enough time must also be allotted to get the "feel" of a new piece of equipment. It is professionally unacceptable to have a training requirement added to already heavy work loads and such a requirement will probably decrease morale and teaching effectiveness. Requiring one to pursue drastic change poses a real threat to one's self-esteem, self-respect and status. It is necessary then for the supervisor to provide encouragement and an environment for improved teaching by helping him through the adoption process. This personal involvement will test the excellence of supervisory abilities, but to settle for less will slow adoption of new equipment.

If a professor has made the effort and results indicate teaching has been improved, then two types of reward must be apparent. First the reward must be evident in his salary. Secondly, and more importantly, he must receive a verbal and written statement of a job well done.

Clearly, teaching excellence is the responsibility of the institution as well as the individual faculty member. Peters and Waterman in their book "In Search of Excellence" provide a significant clue to organizational excellence.[23] They maintain most organizations are composed of average individuals. However, the organizations recognized as excellent have found the means of allowing unusual effort on the part of these average individuals. Logically then, teaching excellence will occur when institutions create the environment to allow the average faculty member to achieve teaching excellence.

The Future

Educational technologies are with us and will continue to be developed at a progressive rate. Payne agrees as she states "There is an emphasis on advanced technology, with computers being used in over 50 percent of all secondary and over 20 percent of all elementary schools throughout the country."[24] As these students - or at least some of them - advance to universities the requirement for professors to use technological tools and be computer literate will inevitably increase.

While predicting the future, nothing can be more certain than that situations will change and the present will never again be the same. It will be a sad day for university faculties if they feel that since they have always had a corner on providing higher education, they will have it in the future. One only has to observe the popularity of the junior and community colleges to realize their students numbers are increasing and - at least partially - at the expense of the 4-year institutions.

A number of private business and training programs already exist in the United States. In a telephone conversation with Comstock, he noted that, "The degree advancement programs offered through such notable organizations as General Motors, Chrysler, Du Pont Chemical, and IBM are for upper divisions of management and engineers to further their skills without the required residence at the university setting. The programs at this time are not accredited but this does not mean much since most advanced graduate programs recognize this type of training and will consider it as prerequisite work toward advanced degrees."[25]

Comstock goes on to say, "a large group of programs offered within business and industry, such as A.T.& T., Texas Instruments, and Sandia Laboratories, develop curriculia cooperatively with universities with degrees granted through the underwriting universities."[26] Wang Institute of Computer Software, Arthur D. Little, Inc., and the Rand Graduate Institute have developed specialized graduate programs accredited by regional accreditation councils. The Naval Postgraduate Program in San Diego and the Air Force Institute of Technology in Ohio are examples of fully accredited programs designed to meet the needs of the military.

"While", as Comstock indicates, "these programs are not as threatening as one might first perceive, they are here and likely to grow." In the future, those which survive will offer higher education most efficiently and effectively based on - among other things - high quality teaching. Only those who are excellent teachers and who are constantly striving to improve themselves will survive in such an environment. High tech educational resources offer promising and exciting opportunities for those who use them.

Summary

High tech teaching tools are here and their availability and use will accelerate in the future. They offer great opportunities to improve teaching situations as well as allowing interaction among people who are great distances from campus.

All this change, however, will try college administrators and individual professors. Administrators must create positive situations for teachers at all levels to involve themselves in observing, experimenting and adopting new teaching technologies. Since technology can improve teaching, especially of effective teachers, this is an opportunity that cannot be neglected

FOOTNOTES

1. Rouche, John E. and Karen Watkins, "A Commitment to Great Teaching". Community and Junior College Journal, Sept. 1982, pages 22-23.

2. IBID., p. 23.

3. IBID., p. 23.

4. Lewis, Lionel S., "Scaling the Ivory Tower". The Johns Hopkins U. Press Baltimore, 1975, p. 19.

5. Roush, D.C. "The Art of University Teaching", NMSU, Las Cruces, NM 88001, 1983, p. 1.

6. Williams, George and Abilard Schuman, "Some of My Best Friends are Professors." Abelard-Schuman, N.Y., 1958, p. 99-105.

7. Boaz, Martha, "Issues in Higher Education and the Profession in the 80's" Libraries Unlimited, Inc. Littleton, CO., 1981, p. 21.

8. Senese, Donald J., "Technology: Developing our Newest and Greatest Resource:, T.H.E. Journal, P.O. Box 364, Arlington, MA 02174, Sept., 1984, p. 90.

9. Kemp, Jerrald, "Planning and Producing Audiovisual Materials", Harper and Row, New York, 1980, p. 6.

10. IBID., p. 6.

11. Denton, Jon J. et. al., "An examination of Instructional Strategies Used with Two-Way Television, "Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, April, 1984.

12. Herschbach, Dennis, R., An Abstract of "Vocational Training and Retraining Through Educational Technology: Policy Alternatives", The Ohio State University, Columbus, Nat'l Center for Research in Vocational Education, 1984.

13. Sardello, Robert J. "The Technological Threat to Education." Teachers College Record, Vol. 85, No. 4, p. 631, Summer 1984.

14. Simpson, Brian "Heading for the Ha Ha", Teachers College Record, Vol. 85, No. 4, Summer 1984, p. 622.

15. Knapper, Christopher K. "Information Technology and Instruction", Information Technology: Innovations and Applications, Shocher, Bernard S., Editor, Josey-Bass, Washington, No. 35, 1982, p.55.

16. IBID., p. 55.

17. Rogers, Everett M., "Diffusions of Innovations", Third Ed., The Free Press, New York, 1983, p. 312.

18. Frye, John, "The Impact of Telecommunications" The Journal, Vol. 10, No. 6, April 1983, p. 88.

19. IBID., p. 89.

20. IBID., p. 89.

21. Cross, K. Patricia, "Not Can, But Will College Teaching Be Improved." New Directions for Higher Ed., Vol. V, No. 1, Spring, 1977, p. 10-11.

22. Weaver, Frederick S., "Teaching, Writing, and Developing", Journal of Higher Ed, Vol. 53, No. 5, p. 591.

23. Peters, Thomas J. and Waterman, Robert H., "In Search of Excellence", Harper & Row, New York, 1982, p. 15.

24. Payne, Judith S., "An In-Service Workshop Approach that Helps Teachers Reduce Computer Anxiety." Descriptive report for the National Institute of Education, Dept. of HEW, Nov 1983, p. 2.

25. Telephone interview with Dr. Dale Comstock, Dean-In-Residence, Council of Graduate Schools in the U.S., Washington, D.C., 17th Oct. 1984.

26. IBID.

"MEGATRENDS" FOR HIGHER EDUCATION

Directions for the Future of College Teaching

by

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"MEGATRENDS" FOR HIGHER EDUCATION

Directions for the Future of College Teaching

INTRODUCTION

The society of the 1980's and 1990's is considered one where changes in economic, social, personal, and educational forces are considered an ever increasing and more dominant characteristic of our lives [3,4]. The professional field of higher education is logically affected by these changes. Professionals in higher education must continue to view themselves as progressive individuals with a focus on long range, strategic planning. This planning process results in action plans that reflect an awareness of environmental opportunities and threats.

An environmental scan can be based on a number of different perspectives. John Naisbitt's best selling text, **MEGATRENDS** [1], identifies one possible set of predictions which could serve as the basis for an environmental scan in the field of higher education. Naisbitt's analysis of articles and news bits from hundreds of newspapers around the country provides the basis for his ten "Megatrends." Naisbitt makes it clear that his predictions are not guaranteed forecasts of the future. They are apparent **trends**, conclusions based on the data he has collected. Naisbitt makes it clear that his "Megatrends" are open to debate and modification. They are a format which will lead to a critical evaluation of environmental issues.

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"MEGATRENDS" FOR HIGHER EDUCATION

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A Research Study

A questionnaire containing a summary of the ten "Megatrends" and an assessment of the probability (0-100%) of the trends occurring and their potential impact (1=low,6=high) was developed.

The "Megatrends" probability impact analysis was used with three professional groups in the general areas of teaching, learning, and management. The survey was used with the College of Business Administration faculty of Marquette University as part of its long range strategic planning process. A second study was done with a national group of business educators. The Association for Business Simulation and Experiential Learning (ABSEL) is an group of educators/consultants who develop computer simulations and structured exercises which are used in both academic and organizational environments. A third study was conducted among training and development professionals of the American Society for Training and Development (ASTD).

While these three groups are not similar, there are similarities which would allow for a comparison of the results. Tables 1 and 2 present the probability and impact ratings for the three groups. Significant differences based on a oneway analysis of variance are indicated.

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Table 1

Higher Education "Megatrends" Summary

MEGATREND	PROBABILITY	IMPACT
We are in a "megashift" from an industrial to an information based society.	75.9	5.33
For every high-technology action, there is a "high-touch" reaction, or the technology will be rejected.	61.5	4.08
Our economy is becoming part of a global structure moving away from isolation and national self-sufficiency. As a result, we will no longer be the world's dominant force.	66.8	4.33
U.S. corporate managers are beginning to think about the long term rather than the next quarter.	49.1	3.91
Our centralized structures are crumbling. We are decentralizing and growing stronger from the bottom up.	50.1	3.92
We are reclaiming our traditional sense of self-reliance after four decades of looking to institutions for help.	50.8	3.66
Citizens, workers, and consumers are demanding and getting a greater voice in government, business, and the marketplace.	57.5	4.30
We are moving from hierarchies to networking; the computer is smashing the pyramid.	55.3	4.32
The North-South shift in the United States is real and irreversible for the foreseeable future.	61.7	3.91
We no longer live in an either/or, chocolate or vanilla world; people have demanded and are getting a multitude of choices.	68.8	4.56

Table 2

"Megatrends" Comparative Ratings

	PROBABILITY			IMPACT		
	ASTD	ABSEL	M.U.	ASTD	ABSEL	M.U.
Information [1,2]	82.6	77.4	67.6	5.58	5.23	5.18
High Touch [1,2]	66.9	63.6	54.0	4.39	4.15	3.70
Global Economy [1]	72.3	67.9	60.2	4.39	4.38	4.23
Long Term [2]	53.2	49.7	44.3	4.44	3.54	3.74
Decentralization [1]	58.5	48.0	43.9	4.24	3.91	3.62
Self-Reliance [1,2]	61.3	50.8	40.2	4.34	3.37	3.26
Greater Voice	61.0	58.8	52.8	4.48	4.03	4.04
Networking [1,2]	62.7	59.1	44.2	4.52	4.59	3.84
North-South [2]	58.7	67.7	58.7	3.50	3.68	4.56
Choices [1,2]	80.0	73.7	52.6	5.06	4.86	3.76

[1] Significant Differences (<.10) exist among groups for Probability ratings.

[2] Significant Differences (<.10) exist among groups for Impact ratings.

The probability ratings can easily be compared because of the similarity of the task. Each group was instructed to estimate the probability of the trend occurring, using a scale of 0 to 100%. This estimate was not based on the environment of the specific group. The impact analysis was specific, however, to the group being surveyed. The ASTD group was estimating the impact of the trend on the field of training and development; the ABSEL group was estimating the impact on simulation and experiential learning; and the Marquette University group was estimating the impact on teaching in business administration (in a particular university setting). The impact ratings used a six point scale:

1 = Low impact, narrow focus
2 = Low impact, broad focus
3 = Average impact, narrow focus
4 = Average impact, broad focus
5 = High impact, narrow focus
6 = High impact, broad focus

The data demonstrate both agreement and disagreement, for each of the ten "Megatrends", on both the probability and impact ratings. A detailed summary for each "Megatrend" is presented in Exhibits 1 to 10. The focus is on an interpretation of the specific impacts identified. Additional statistical information, means, ranges, and standard deviations, are also presented.

"MEGATRENDS" FOR HIGHER EDUCATION

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Megatrend #1

WE ARE IN A "MEGASHIFT" FROM AN INDUSTRIAL TO AN INFORMATION BASED SOCIETY.

Probability of Occurrence	Degree of Impact
Mean: 75.9	Mean: 5.33
Range: 30-100	Range: 4-6
Std. Dev.: 16.19	Std. Dev.: .71

IMPACTS

Training

More computer assisted training and self-directed learning.

Need to train everyone how to use a computer, computer literacy.

More emphasis on "broad-based" or "gray area" training; less "either-or" and "yes-no" training.

How to train "information" managers and a work force where employees are more knowledgeable than managers.

Higher education professionals will need even more to be "resource" specialists.

Need for high tech training. Need for basic communication skills, speaking and writing.

Training focusing on data, information, decision-making, and planning.

More computer-based training for adult education and retraining.

Higher Education

Expand breadth of simulations to include or serve a broader set of disciplines like Political Science and Public Administration.

More use of computers for games in courses and to analyze data gathered in courses and to give feedback to students on their performance.

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Megatrend #2

FOR EVERY HIGH-TECHNOLOGY ACTION, THERE IS A HIGH-TOUCH REACTION OR THE TECHNOLOGY WILL BE REJECTED.

Probability of Occurrence	Degree of Impact
Mean: 61.5	Mean: 4.08
Range: 10-90	Range: 1-6
Std. Dev.: 19.47	Std. Dev.: 1.24

IMPACTS

Training

There will be an increased need to emphasize human relations factors in the work force.

Greater need for human resource management and interpersonal skills training.

More participative interactive training sessions; less tolerance for lecture "how to."

The need to develop programs on dealing with change to accompany changes in technology.

Increased need for human relations training to compensate for increased pressures between individuals.

Help others change values and beliefs toward high-technology, gaining acceptance of new learning delivery systems.

Emphasis on "quality of worklife"; organization deve[illegible] programs.

Higher Education

Demand for more interpersonal competence.

Qualitative approaches balancing out quantitative emphasis.

Incorporation of personal development as an objective in more learning exercises.

Megatrend #3

OUR ECONOMY IS BECOMING PART OF A GLOBAL STRUCTURE, MOVING AWAY FROM ISOLATION AND NATIONAL SELF-SUFFICIENCY. AS A RESULT, WE WILL NO LONGER BE THE WORLD'S DOMINANT FORCE.

Probability of Occurrence	Degree of Impact
Mean: 66.8	Mean: 4.33
Range: 20-100	Range: 1-6
Std. Dev.: 21.38	Std. Dev.: 1.37

IMPACTS

Training

Cultural training and language skill development will be important.

More integration of thoughts and other cultures which will definitely impact on values and systems.

More multi-lingual training required; more employees will have to be multi-lingual.

Developing training programs and interventions that will strengthen people's ability to think in a larger (global) framework.

Cross-cultural training will be vital. We'll all have to learn to overcome our prejudices and learn to focus in the practical issues of humanism and goal orientation.

Global sharing of training skills and techniques. Americans are "shocked" to learn the degree to which our philosophies and approaches are culture bound.

Higher Education

Activities need to be designed so that students are exposed to a multi-cultural dimension.

More emphasis on material having an international emphasis.

A greater need for a specialized type of information training.

Megatrend #4

U.S. CORPORATE MANAGERS ARE BEGINNING TO THINK ABOUT THE LONG TERM RATHER THAN THE NEXT QUARTER.

Probability of Occurrence	Degree of Impact
Mean: 49.1	Mean: 3.91
Range: 0-100	Range: 1-6
Std. Dev.: 23.45	Std. Dev.: 1.40

IMPACTS

Training

Inclusion of Higher education in initial corporate planning.

Trainers will need to know more about the use of trends, conducting environmental scans, futuring, etc.

No change -- unfortunately we'll still be a voice crying in the wilderness.

"Management training" and new economic structures are needed to make it worthwhile to commit resources beyond one or two quarters.

Higher Education

Long term exercises, extending beyond the traditional semester.

Courses that stress strategic long range planning.

Go to more long term thinking and structure simulations and classes longer than single semesters.

Could lead to more complete and more realistic approaches to thinking and extensive use of simulations.

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Megatrend #5

OUR CENTRALIZED STRUCTURES ARE CRUMBLING. WE ARE DECENTRALIZING GROWING STRONGER FROM THE BOTTOM UP.

Probability of Occurrence	Degree of Impact
Mean: 50.1	Mean: 3.92
Range: 10-100	Range: 1-6
Std. Dev.: 21.10	Std. Dev.: 1.26

IMPACTS

Training

Greater need for management skills development, especially in areas of group dynamics and participative approaches.

The focus of an organization on greater community and state involvement in order to effectively lobby for favorable local laws. This means more effective public speaking skills for managers who represent their organization in the community.

Self initiative in training, career development.

Need to develop new skills and competencies to successfully function in a decentralized organization. Need to examine how to help employees learn new behaviors and norms that come from structural change.

Training would become more diversified and probably conducted more at the request of individuals and work group leaders instead of management.

Greater involvement and participation in local concerns; increased public and community relations responsibilities.

Higher Education

We must educate our students to be change agents, ready to accept a dynamic environment.

More stress on individual/interpersonal problems in coping with change.

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Megatrend #6

WE ARE RECLAIMING OUR TRADITIONAL SENSE OF SELF-RELIANCE, AFTER FOUR DECADES OF LOOKING TO INSTITUTIONS FOR HELP.

Probability of Occurrence	Degree of Impact
Mean: 50.8	Mean: 3.66
Range: 20-100	Range: 2-6
Std. Dev.: 22.80	Std. Dev.: 1.27

IMPACTS

Training

Social service agencies will need more training to cope with self-sufficiency.

Teaching others to accept individual responsibility.

Trainers will trend away from behavioral orientation toward more humanistic orientation.

More emphasis on self-directed learning.

More continuing education; health and wellness have become part of the "educational industry" rather than the health industry.

Higher education will probably have to "fill in" all of the educational gaps these poor kids will have.

Higher Education

Meaningful decision-making; when do you know you have enough information to make a decision -- related to the degree of self-reliance sought.

Move toward individual rather than group analysis.

Need to teach participative skills, responsibilities, and commitment.

Megatrend #7

CITIZENS, WORKERS, AND CONSUMERS ARE DEMANDING AND GETTING A GREATER VOICE IN GOVERNMENT, BUSINESS, AND THE MARKETPLACE.

Probability of Occurrence	Degree of Impact
Mean: 57.5	Mean: 4.30
Range: 10-100	Range: 1-6
Std. Dev.: 23.24	Std. Dev.: 1.53

IMPACTS

Training

More input and monitoring from outside the organization of what higher education programs are offered.

Organizations are finding themselves coping with greater public demands and media exposure.

Greater rejection of poorly planned and executed training.

This has tremendous impact for communication/interpersonal skills training. If people want a "voice" they need to know how to use it.

Greater demand for training in leadership skills, how to gain and maintain power, negotiation skills, etc.

Creates a greater diversity of education and topics. Our schools are not putting out trainers either in numbers or capabilities to handle this. Many universities look at HRD and Education as lower status departments.

Higher Education

Greater emphasis on social impact of decisions.

Simulations about social issues and political activism.

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Megatrend #8

WE ARE MOVING FROM HIERARCHIES TO NETWORKING, THE COMPUTER IS SMASHING THE PYRAMID.

Probability of Occurrence	Degree of Impact
Mean: 55.3	Mean: 4.32
Range: 10-100	Range: 1-6
Std. Dev.: 23.41	Std. Dev.: 1.44

IMPACTS

Training

More emphasis on how to work _with_ people instead of _for_ them. Less training on the rules and more on dealing with people.

Computer literacy will be imperative and the older workers will need help with skill levels and acceptance.

This is particularly true in job hunting skills, career development, and upward mobility training. Support groups are vital to development and we need to learn to use them more through training.

Personal networking skill training needs to be offered to the working class.

Need to train people in collaborative approaches to working and living, especially with increased isolation due to computers.

Higher Education

Teach how to design and understand networks! Develop networking competencies.

Information monitoring skills must be build into teaching materials.

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Megatrend #9

THE NORTH-SOUTH SHIFT IN THE UNITED STATES IS REAL AND IRREVERSIBLE FOR THE FORESEEABLE FUTURE.

Probability of Occurrence	Degree of Impact
Mean: 61.7	Mean: 3.91
Range: 0-100	Range: 1-6
Std. Dev.: 26.55	Std. Dev.: 1.50

IMPACTS

Training

Northern areas must learn to adapt to this trend; use of automated equipment and facilities.

Don't agree -- Northeast is still the mecca for education.

Those moving south must be oriented to a specific culture where many stereotypic biases are not true but where traditional values are still upheld. A different kind of cross cultural training is needed.

Increased demand to community and cultural education.

Greater labor competition, more retraining, break up of present dominant industries.

Higher Education

Emphasis on radical change based on crisis. Structural conflict and contradiction might become key concepts for understanding change, through different disciplines.

Input energy, relocation, labor force characteristics, consumer movement, state regulations into decision-making.

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Megatrend #10

WE NO LONGER LIVE IN AN EITHER/OR, CHOCOLATE-OR-VANILLA WORLD, PEOPLE HAVE DEMANDED AND ARE GETTING A MULTITUDE OF CHOICES.

Probability of Occurrence	Degree of Impact
Mean: 68.8	Mean: 4.56
Range: 20-100	Range: 1-6
Std. Dev.: 19.49	Std. Dev.: 1.25

IMPACTS

Training

Strategy -- teaching people to THINK!

Demands for higher education programs to be based on individual needs rather than larger group needs, more specific tailoring of programs.

Many individuals are not sophisticated about making choices. They will need help with problem solving and decision making skills.

Need for greater availability of specifically tailored instruction. Greater use of computer based instruction.

Development of a variety of training techniques and styles to meet individual needs of trainees.

Employees will choose their learning from a "cafeteria" rather than a set curriculum.

Higher Education

Teaching people how to deal with ambiguity.

Go into cafeteria style grading and experiment more with optional classroom activities that meet different needs of different students.

Need to teach more complex decision-making methods, including highly subjective or personal critieria.

"MEGATRENDS" FOR HIGHER EDUCATION

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While there is widespread disagreement about some of the "Megatrends", both in terms of the probability of their occurrence and their impact, there is also substantial support for actions which must occur for the field of higher education to continue taking an active role in human development.

Professionals in higher education must continue to take a strong role in the action planning that is associated with the assessment of impacts. Directions are not enough; action planning and results will be the real determinants of the profession's ability to deal with the future. Professionals in higher education need to develop two of the key concepts from **In Search of Excellence** [2]. Communication about issues must be increased and a "bias for action" must be developed that causes the profession to take steps that deal directly with those "Megatrends" that are going to impact significantly on college teaching.

Bias for Action

The "bias for action," follows the analysis of their probability and impact. From the individual responses, there are proposed actions which would likely receive substantial support from the profession. Individual actions are indicated for the "Megatrends." However, there are four strong issues that seem common to this entire project.

Action Call: There is a substantial need for new educational programs. Despite the recognized volume of educational programs, there were widespread demands for new programs throughout the "Megatrend" analysis. For every trend, individual responses were recorded that asked for and identified specific programs that are not currently available. Program needs were identified in cultural issues, communication skills, computer literacy, human relations, planning, decision-making, career development, and leadership skills. These programs will have new content, new approaches, and be delivered using the new technologies.

Action Call: There is a major need for improved communication about what education does and how to do it. The wealth of educational programs currently available makes the first "action call" hard to accept. The number of programs available for some of these topics is substantial. Despite this reality, there is substantial support among the survey respondents that these programs will not meet the demands of the future. Alternatively, there is some evidence that professionals face difficult decisions in identifying the appropriate program when faced with the "multitude of choices."

Action Call: There is a need for more programs that effectively use the principles of self-directed learning and self-choice about what is learned. There was a substantial reaction throughout the research that there will be more focus on identification of individual learning needs and individualized approaches, often computer-based, to learning. While the term is common in the compensation area, the idea of "cafeteria" education may be new, and frightening, to many. It will require a radically new approach to education in some institutions.

Action Call: There is a need for new teaching methods. This is a surprising outcome of the research. An assessment of teaching techniques shows there are teaching approaches for almost any subject and any audience. Yet the respondents in this research seem to be generally concerned about new ways of presenting content. There was substantial concern over the ability of the computer to become a major delivery vehicle for higher education. The problems of successful computer-assisted instruction and the continuing need for personal, instructor contact appear to be a call for new approaches. While ideas were generated for specific actions in other areas, this call for action appears to be a hope for some yet-to-be discovered teaching strategy.

SUMMARY

The directions for higher education and college teaching identified above are meant to be clearly one interpretation of the results of this research project. In reality, it is the organization itself and the individual professionals which will identify and decide, by their actions, the directions the field of higher education will take as a result of the "Megatrends." The materials presented here are an attempt to increase the amount of information available to individuals facing these trends and focus on the "bias for action" that is necessary to continue leadership in the field of higher education.

REFERENCES

[1] Naisbitt, John. Megatrends. New York: Warner Books, 1982.

[2] Peters, Thomas and Robert H. Waterman, Jr. In Search of Excellence. New York: Harper and Row, 1982.

[3] Toffler, Alvin. The Third Wave. New York: William Morrow and Company., Inc., 1980.

[4] Toffler, Alvin. Future Shock. New York: Bantam Books, 1971.

Author's Note: Additional results from the individual surveys, including a complete set a statistical data, the analysis of variance, score distributions, etc., are available from the author upon request. Copies of all comments are also available.

A BRIGHT FUTURE FOR INSTRUCTIONAL TELEVISION THROUGH TECHNOLOGY

by

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A Bright Future for Instructional Television Through Technology

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Introduction

For the past 40 years educators have been investigating the use of instructional television for improving the efficiency of the educational process. To date very little of the potential offered by the electronic media has been realized in higher education. Many times in the past predictions were that a large percentage of college classes would be using television. Even with the major innovations, such as videotape recorders, instructional television has not enjoyed large acceptance.

We have been using television in some of our classes for the past three years, and we have been investigating some unique aspects of the medium. This is a report on some of our observations and predictions for instructional television.

Television in Classes

Our delving into the instructional television was for the purpose of increasing the efficiency of education and for freeing students from the time and place constraints imposed upon them. We initiated our studies at a time when conservation of energy was a goal. We originally tried to imagine the future in higher education with technology being used to alleviate some of the constraints. We envisioned students not constrained to attend classes every MWF at a predetermined time, but receiving instruction from videotapes using a videotape recorder-player at home. The students could come to campus for tests or individual instruction when appropriate. We also envisioned that many students would communicate with the instructor by microcomputer.

The first question that arose was, "Is instruction by television as effective as instruction by live lecture?" We found that this question was not addressed very well in the literature. Since we wanted some experience using television we decided to try to address this question while gaining instructional television experience. Our approach to using televised instruction was to televise regular lectures in the classroom. This seemed appropriate because one of the disadvantages often listed for instructional television was the high cost, in time and money, for production.

Three entire courses were videotaped in the classroom. To evaluate the effectiveness of learning by televised lecture compared with live lecture, each class was randomly divided into two groups. While the lecture was given to one group live, and being videotaped, it was televised in an adjacent room to the second group. Each group received exactly the same lecture, the only difference being the medium of presentation, live or televised.

During the semester the groups were given exactly the same tests at the same time. There was no significant difference between the learning of the groups as measured by the tests. To insure that the groups were similar in learning ability, the overall grade-point-averages and the SAT scores were compared. In each class the groups were similar by these standards.

The results from one of these classes, Engineering Economy is shown in Figure 1. The results were very similar in the other classes tested this way. The conclusion was that in many classes students can learn as well by televised instruction as by live instruction. Significantly, this televised insturction can be accomplished through inexpensively produced tapes from a regular lecture.

During our studies the videotapes were placed in the library to be available for student use after the class. We maintained records of the use of these videotapes, and discovered that the students will use videotapes if they are available. A graph of the useage of these tapes between exams is shown in Figure 2.

On the basis of the positive results obtained in these studies, we propose that televised instruction can be used effectively in several ways:

1) Videotaped courses can be televised to a classroom at several different times for large or multiple section classes.
2) Entire courses can be put on videtape and sold to the students at registration. An entire course of 45 hours can be put on 6 tapes at a cost to the student of approximately $5 per tape. The student can have a videotape recorder at home at a cost of approximately $300. Over a 4 year period, these costs amount to about one extra book per semester.
3) Videotaped instruction for laboratories can be a tremendous improvement for demonstration of instrumentation or principles.
4) As a minimum, faculty members can videotape lectures for televising when he cannot be in class.

Time-Compressed Videotapes

Recent advances in video and audio technology have provided new opportunities for exploiting the potential of instructional television. Specifically, hardware now available is capable of providing broadcast quality, time-compressed videotapes suitable for use on regular videoplayers. This technology captured our interst three years ago, and we have studied its use in the classroom.

We had several sets of lectures (5 to 6 lectures from a single class) time-compressed by 30 per cent and one set of 5 lectures compressed by 40 per cent. We have performed several experiments for comparing learning from regular-speed videotapes with that from the time-compressed videotapes. In all of our comparisons, experimental procedure was established wherein the only variable was the method of presentation of the lecture.

In three courses, the learning via televised lectures at regular speed was compared with the learning via 30 per cent time-compressed televised lectures. During these comparisons the class was randomly divided into two sections. One section saw regular-speed lectures and the other group saw time-compressed lectures. At the end of each lecture, each group was administered the same short test. At the end of a set of 5 or 6 lectures each group was administered an exam covering the material in the 5 or 6 lectures. A typical comparison of the results is shown in Figure 3. It was our conclusion after the comparisons that students in some classes can learn as well from 30 per cent time-compressed televised lectures as they can from regular-speed televised lectures. Our comparisons using the 40 per cent time-compressed lectures indicate that this speed is too fast for many of the students.

We learned much from our studies with time-compressed videotapes, but we raised as many questions as we answered. We know students can learn well from time-compressed television. Efficiency of learning can be increased, possibly even total learning can be increased, because of the increase in the students attention to the lecture. It has become obvious that using time-compressed television efficiently is a complex undertaking. The compression rate must vary with many factors such as the material being presented, the presenter, and the learner. Using videotapes time-compressed at a specific rate is feasible in the classroom. However, inexpensive variable-speed tape players must be available before time-compressed instructional television will enjoy widespread use. This technology is iminent. In fact, at UTEP we have adapted available hardware for this use already.

Improved Hardware for Instructional Television

To effectively use time-compressed videotapes, a student must be able to choose the speed of the presentation. Inexpensive variable-speed tape players of good quality have been available for several years. For the past two years, inexpensive variable-speed videotape players have been commercially available. These players have good quality video, but the audio does not work properly when the speed is changed from regular speed. During the past several months we have modified a variable-speed audiotape player to work with the variable-speed videotape player. Therefore, a regular videotape can be used at whatever speed desired. This technology will most surely be commercially available in the near future.

Interactive learning with a television or a computer is another very important concept that is developing. For a time it seemed that videodiscs would be the hardware used for interactive learning. But the high initial costs seem to have precluded their growth and wide spread use.

Interactive learning from videotapes has not been possible because of the inability to rewind easily to a chosen position on the tape. The new variable-speed videotape players contain hardware which has overcome this shortcoming. Even though they are not as fast as videodiscs, videotapes can now be used effectively for interactive learning.

Conclusion

Even though instructional television has not grown as much as was expected by many, new developments in the technology of television make the possibilities even more interesting. One of the largest obstacles of instructional television is the present system of education. The rigid system under which most of us teach makes it difficult to incorporate instructional television into the teaching-learning process. Instructional television will undoubtedly have a brighter future in environments that encourage innovation and improvement in the process.

Selected References

1. Tarquin, Anthony, Lionel Craver, and Darrell Schroder, "Student Performance in Televised Lectures," Journal of Professional Issues in Engineering, American Society of Civil Engineers, Vol. 109, No. 3, July, 1983, pp. 208-213.
2. Schroder, Darrell C., W. Lionel Craver, Jr., Anthony J. Tarquin, and Po-Wen Hu, "Learning from Time-Compressed Videotapes," Institute of Electrical and Electronics Engineers Transactions on Education, Vol. E-26, No. 4, November 1983, pp. 168-170.
3. Tarquin, Anthony J., W. Lionel Craver, and Darrell Schroder, "Effects of Time-Compression of Videotapes on Student Learning," Journal of Professional Issues in Engineering, American Society of Civil Engineering, Vol. 110, No. 1, January, 1984, pp. 19-24.

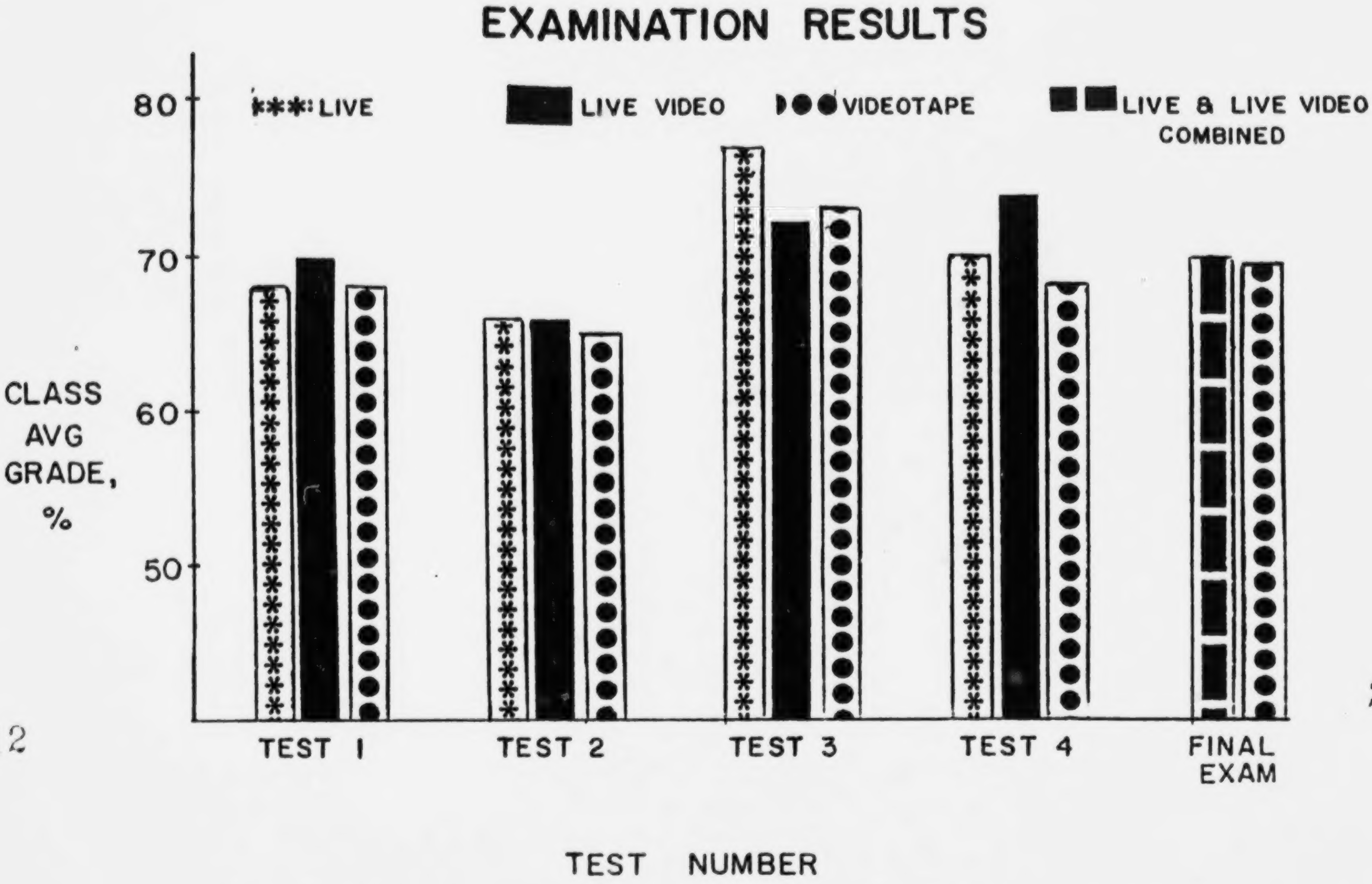

Figure 1. Comparison of Learning from Live Lecture and Televised Lecture for Engineering Economy

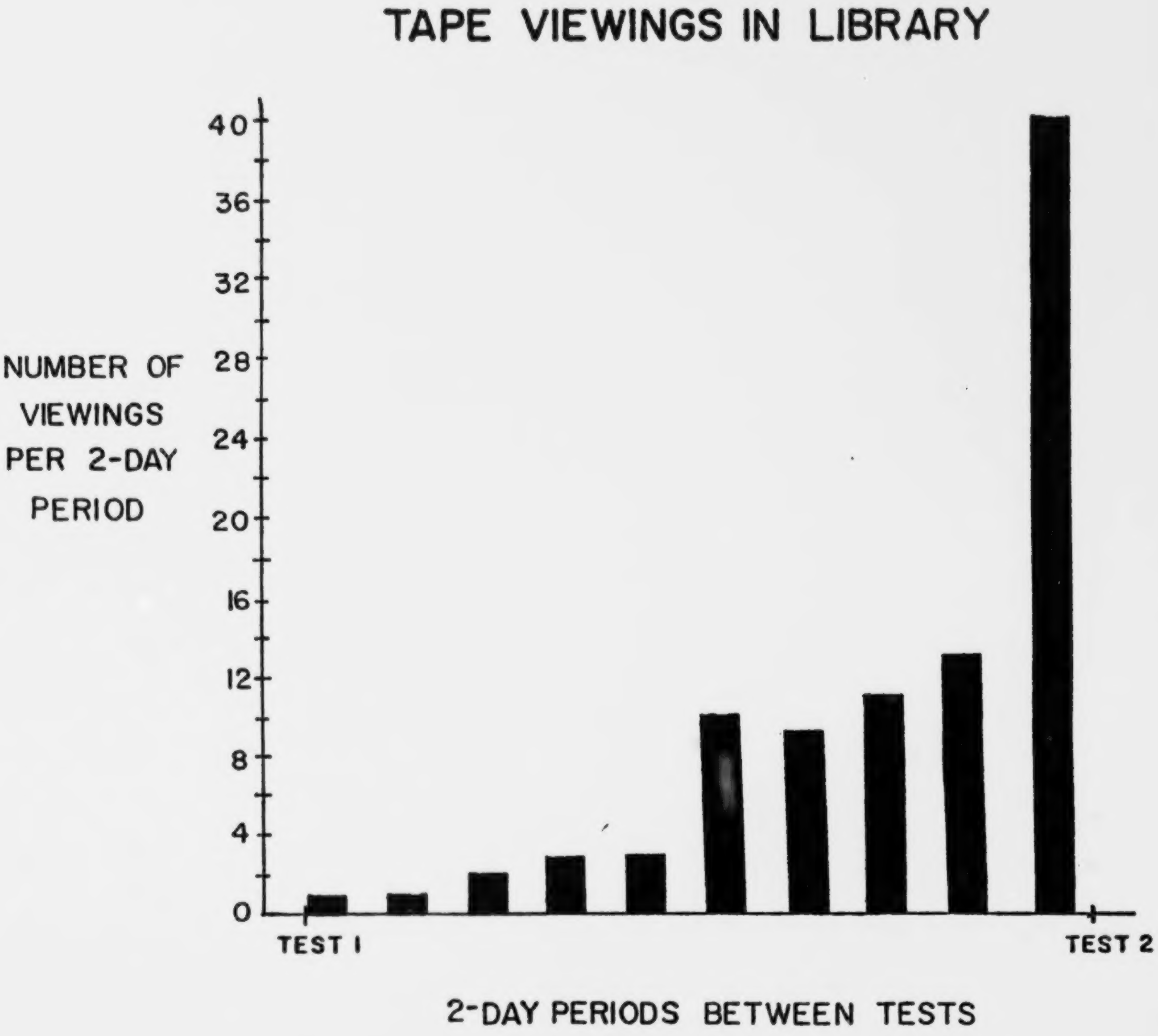

Figure 2. Videotape use in Library for Engineering Economy

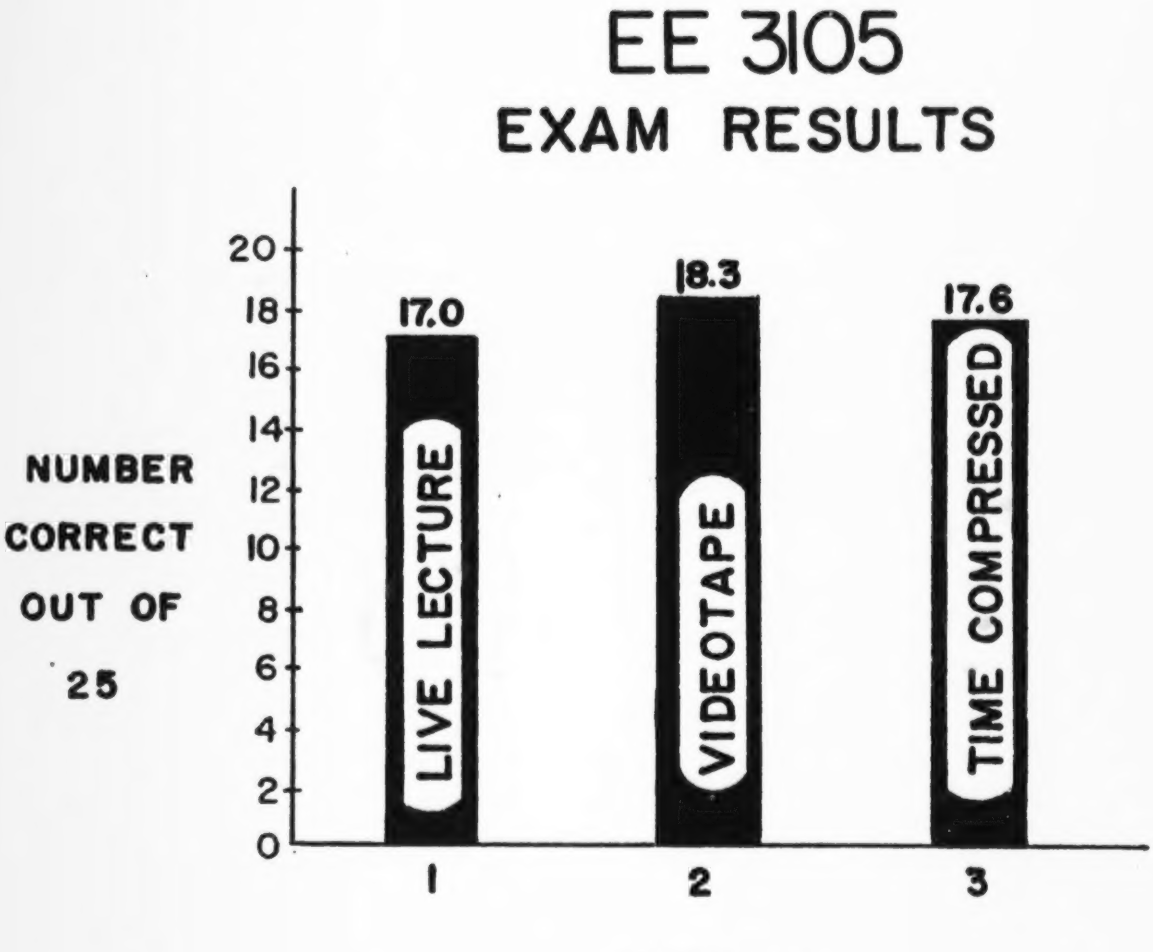

Figure 3. Comparison of Learning from Live Lecture, Televised Lecture, and Time-Compressed Televised Lecture for Introduction to Electrical Engineering

CAN COMPUTER ATTITUDES INHIBIT TEACHING TO POTENTIAL?

by

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Can Computer Attitudes Inhibit Teaching to Potential?

Educators who contemplate the challenge of preparing students for the future are presented with a dilemma. A design for "teaching to potential" must surely include training to permit teachers to function in the computer-intensive culture of the near future. Yet, attitudes developed within the value structure of a traditional society may prohibit full utilization of these new teaching tools:

> (Mrs. Boyden's) reputation as a teacher of chemistry has stood for decades among the highest in secondary education. ...Her gray-white hair is swept high on her head. She often wears a pearl chocker, a silver bracelet, a gold watch, a silver pin...On the blackboard she has written, "The sins we commit two by two, we pay for one by one." The next day: "There are few concepts so difficult that they do not yield to the repeated attack of the ordinary mind." She plays games with the boys (of the academy), giving them gradeless quizzes, drawing them out as if they were around a dinner table. "Victor," she said to one, years ago, "when will you stop trying to remember and start trying to think?" Victor Butterfield is the president of Wesleyan University, and that is his most highly valued story about his own education. (pp. 428-431)
>
> John McPhee
>
> The Headmaster: Frank L. Boyden, of Deerfield

This description of Mrs. Boyden as a teacher seems to epitomize the mental vision many of us have of "teaching to potential." It is of a teacher, often employing the Socratic method of questions and answers, who is able to stretch the minds of students by forcing them to think, not just remember. This model of exemplary teaching represents a traditional society.

The goals of mind-stretching and helping students to progress from rote/recall types of learning to higher thinking are as valid today as they were yesterday. Good teachers, such as Mrs. Boyden, are still the heart of good schools. Yet, ours is no longer a traditional society, but a post-industrial information-based high-tech culture. Communities are pushing education to extend and elaborate the definition of good teaching to include the use of the products of our technological society, particularly computers, to help students to become better thinkers. School districts and institutions of higher education have rushed to embrace this new technology.

Hunter, Dearborn, and Snyder (1983) have reported a variety of activities in a program in two suburban districts near Washington, D.C. which integrated computer usage in a K-8 curriculum.

> ...kindergartners spent class time last year on testing and debugging procedures that controlled their imaginary robot friend, ZEEP. ... Fourth graders developed their own procedures for learning fractions by computer. Sixth graders used computer programs to help analyze the results of their science programs. They used word processors to experiment with and improve their compositions...(p. 115)

These activities exemplify what many computer advocates consider to be the strength of the computer--"its ability to help children think--to help them understand complicated concepts by placing them in a context that is relevant to children." (Papert, 1982, p. 86). If so, then this may be the model for "teaching to potential" in the 1980's and the future.

Can this goal be realized? Or are there barriers which may block the promise of incorporating the full power of computers and technology into education and teaching? The purpose of this paper is to examine attitudes about computers and technology which could undermine efforts to improve teaching through implementation of comprehensive programs of educational computing.

Computer Attitudes

Attitudes about computers have been neither well-defined, nor well researched. While computers have been in use in schools and universities since the late 50's and early 60's, their use was confined to a small segment of the educational community. Now the enormous teaching and learning potential of the computer has become available to a much broader spectrum of society because of the relatively low cost and accessibility of the microcomputer in contrast with the large mainframe computer.

The explosive nature of this development has resulted in computer attitudes which range from wild enthusiasm to highly negative rejection (with some degrees of caution, confusion, and skepticism in between). Research monographs, journal articles, and reports in the press have dealt with student attitudes, teacher attitudes, and attitudes in the general society about computers.

Enjoyment, anxiety, efficacy, and education computer support. In a broad-based assessment of computer awareness and literacy of eighth and eleventh-grade students in Minnesota, Anderson, Klassen, Krohn, and Smith-Cunnien (1982) included an affective component. This component measured computer attitudes in four dimensions:

> enjoyment...(degree to which a student enjoys working with computers); anxiety....(level of anxiety or stress associated with using computers); efficacy...(sense of confidence in ability to use computers); and education computer support... (degree to which a student feels positively about computers in education) (p.39).

Resistance/receptiveness to educational innovation. Certain attitudes of teacher resistance to the use of microcomputers in teaching have their roots in past experiences with educational innovations. For teachers and administrators attitudes of opposition to computers may not simply be inertia nor a fear of the unknown, but due to historical precedent.

> "The wariness of educators to embrace the new technology of the personal computer lies in the broken promises of earlier technological innovations--computer-aided instruction in the 60's, programmed learning by teaching machines, educational television...None of these became integrated into curriculum, and while there may have been some partial successes, these innovations failed to revolutionize education as their advocates promised." (S.D. Smith and W.D. Smith, 1984, p. 28).

Technophobia. "Technophobia" has been characterized by Porter (1984) as:

> ...the underside of a humanistic preoccupation with the personal, the aesthetic, and the spiritual: a fear of and disdain for the "blind monster" technology and all its works and pomp...

Porter attributes this hostility to what machines represent and negative reactions to the computer to the fact that computers perform quasi-personal functions in society generally. For many teachers, this depersonalization is a real threat. In Philip Jackson's "The Way Teachers Think" teachers' thinking is characterized as "a romantic view of the world" (p. 36). He described this view as including a focus on individuals, intuitive thought, a tendency toward sentimentality, with a resistance to generalizations, abstractions and analytic thought. Jackson emphasized: "Teachers are constantly thinking and talking and acting in terms of people, not just people in the abstract, but particular people" (p. 28).

Computer Anxiety. The term "computer anxiety" has been used with a wide variety of connotations and implications. In fact, one might find that it has been used in much the same amorphous way that the term "computer literacy" has--with particular meanings for different users of the term, and no generally agreed upon definition. While some might consider the term "computer anxiety" to be synonymous with "technophobia," the attitudes which are associated with "computer anxiety" in the framework of this paper are those associated with mathematical and technical competence. As Winkle and Mathews (1982) have said, "Feelings of anxiety when confronting anything 'mathematical' readily spill over to computers" (p. 315).

Sex-role stereotyping. Closely allied to computer anxiety is sex-role stereotyping as a computer attitude. This attitude that computers are a male domain, and that computers are too complex for females is described by Gilliland (1984):

> ...computer arcades are dark, noisy places which attract boys and men; high school computer science courses reflect high male enrollment figures; parents fill after-school computer classes and computer camps with their sons, not their daughters. The actions of parents and society combine to demonstrate to girls that computers are not for them (p. 42).

Age-related attitudes: traditional society attitudes vs. computer culture attitudes. The positive attitudes which Anderson et al. (1982) characterized as "educational computer support" are not only present in adult society (as well as among the students and young people), but have been responsible for decision-makers embracing the new technology with investments in hardware and software and the mandating of teacher and pupil training in computer literacy. Yet, there is a distinction between attitudes toward computers held by younger people to whom this technology seems commonplace, and those held by many older people whose education and training occurred before the advent of educational computing.

Attitudes of "computer culture" grow from the fact that today's students accept computers as being part of everyday life. Computer games, personal computers in the home, television advertising, television programs and movies in which the heroes are young people with computer skills...all combine to give students a sense of being well-acquainted with computers.

In contrast with this attitude of considering the computer commonplace, traditional attitudes are associated with teachers and other adults who were educated in a society where computers were safely relegated to large air-conditioned rooms run by technicians. These individuals do not have the feeling of ease with computers that many younger people seem to have. Widmer and Parker, 1983, refer to the age-difference in attitudes: "...adult uneasiness is often compounded by witnessing children who undauntedly take to the computer as they did to T.V." (p. 23). In other words, fears of ineptitude, and feelings of tentativeness about computers may be exacerbated in teachers who see the competencies of their students rapidly surpass their own skills in computer usage.

Computer Attitude Related Research

Research on attitudes and feelings about computers, particularly teacher attitudes, is scarce and fragmentary. Much of what has been written about computer attitudes is the nature of opinion, which may or may not be based on experiences and observations. However, there has been research that can be examined from which attitudes can be inferred. For example, research which has documented computer usage can be show to have implications related to computer attitudes.

Computer enjoyment, anxiety, efficacy, and educational computer support. The Minnesota Computer Awareness and Literacy Assessment was administered to a total of 3,615 eighth and eleventh grade students in Minnesota in 1979 (Anderson et al. 1982). These Minnesota students were reported to have moderately high levels of enjoyment of computers, but with some degree of uncertainty concerning their feelings. Eighth graders seemed to enjoy working with computers slightly more than eleventh graders. Students at both grade levels expressed little anxiety about working with computers, yet their sense of confidence in working with computers ("efficacy") was not high. Researchers found that students were generally positive and supportive toward the use of computers in education, but with some uncertainty about what educational computing should be. It was reported that students who had had computer courses or with computer experience were significantly (.05 level) more positive in their computer attitudes, but not dramatically different from students who had no exposure to computers.

Resistance/receptiveness to educational innovation. Stevens (1984) has reported the results of three different Computers in Education surveys given in Nebraska in 1979, 1981, and 1982. In the 1979 and 1981 surveys, a large majority of respondents showed receptiveness to the belief that high school students should be computer literate, but few reported themselves able to teach computer literacy. Only 9% ~~of~~ higher education faculty reported this skill.

In the 1982 survey, there were predictions by educators that computers would have a strong influence on curriculum and classroom instruction in the future. Interestingly, teachers did not respond positively about the future of computers in their own classrooms. Over three-fourths of subjects:

> viewed their methodology as either not being conducive to microcomputers, or they were not sure if microcomputers would blend with their instructional techniques...In other words, educators in this study perceived that computers would strongly influence classroom instruction and curriculum, but not in their classrooms (Stevens, 1982, p. 55).

Sex differences in computer usage. In a study of students in summer computer camps and classes, Miura and Hess (1984) examined sex and socioeconomic status (SES) enrollment differences. They found that males outnumbered females by a percentage of roughly three to one. In addition, they determined that "the disparity between boys and girls increases with age, is greater in advanced than in beginning classes, and is larger for expensive programs" (p. 22). They also found that participants were overwhelmingly Caucasian and predominantly middle and upper income (98%).

In an investigation of the male-dominated culture of computing, Kiessler, Sproul, and Eccles (1983) surveyed video arcade use. The premise of their study was that the culture of computing is controlled by males who "design the video games, write the software, sell the machines and teach the course (with few exceptions)" (p. 42). In a video arcade survey they found that the population was 175 male to 30 female. Some girls were playing the games with groups of girls, most were simply observing boys. None were playing alone. The authors concluded that "Cultural factors and expectations, rather than any inherent disadvantage in capabilities, seem to keep girls out of arcades and away from computers" (p. 48).

A recent survey of 1,242 people by USA TODAY (Manning, 1984) found males the main users of home computers, with adult males accounting for 43% of the use, followed by male children with 27% being the main computer user in their household. Only 15% of female adults were the main computer users of the home, with female children being the least likely to be the major computer user in their families.

Teacher and student computer confidence and sex-typing attitudes. In a study conducted in a southwestern community known for academic excellence (S.D. Smith, 1984) examined computer confidence and sex-typing attitudes in relationship to sex, grade level, and teacher influence. While not unique in the United States, the school district in which the study was conducted is certainly advanced in its implementation of computer literacy in comparison with most school systems. A curriculum designed for computer instruction across grade levels has been in place for more than a year. All students throughout the grades are required to take computer literacy courses. In the survey only 10% of the teachers responding indicated that they had not had any introduction to computer literacy or awareness.

A random sample of students from levels 1-12 were tested, together with all teachers. Comparisons were made by grade level (students' grade level and level taught by the teacher), sex, and teachers vs. students. Elementary level respondents were found to be significantly more confident that junior high or high school level, and students were found to have significantly more confident attitudes that teachers did. Interestingly, there were not significant differences between males and females in their attitudes of "efficacy" or confident in ability to use computers.

On the sex-typing attitude scale there were no significant differences by grade level, nor between teachers and students. All groups showed a high degree of belief in equality of the sexes in computer and science abilities and careers. However, there were significant differences between males and females, with females showing a stronger belief in equity. Males showed more of a tendency to beliefs that computer study and careers are better suited to men and boys.

Perhaps the most interesting finding of the study was in the results of a classic regression analysis. Teacher confidence scores were significantly and negatively related to student confidence scores. This seemed to indicate that as students' confidence went up with more exposure to computer classes, apparently teachers' confidence went down. Despite teachers having had introductory courses, apparently their feelings of confidence lessened as they saw their students becoming more skillful and competent in their use of computers.

Technophobia and computer anxiety. These attitudes of fear of depersonalization, and anxieties that are linked to concerns about math and science may be the most frequently named as "computer attitudes." Yet, with the exception of the Minnesota computer literacy study, there appears to be a lack of actual research about these attitudes. Math anxiety research has been cited to make a case for females transferring math fears to computers (Winkle and Mathews, 1982). Research is needed in this area to determine the nature of these attitudes.

Conclusions

The tantalizing promise of computers and the new technology to enhance the teaching process is a long way from being realized. The challenge and complexity of developing curricula, choosing appropriate hardware and software, and training teachers and students have been widely acknowledged in educational and community circles. Yet, all the efforts which have been made may be to no avail unless decision makers realize the importance of teachers' attitudes regarding computers.

It is generally agreed that attitudes influence the way that people think, feel, perceive, and behave toward certain objects. The attitudes which teachers hold about computers may determine the future of educational computing. Attitudes of resistance to the implementation of computers may have their origins in past experiences with educational innovations, in technophobia, computer anxiety, sex-role stereotyping, or age-related experiences. Whatever their roots, negative computer attitudes may result in teachers who acknowledge that computers will influence education in the future, but not in their classrooms (Stevens, 1984).

In a survey of school districts around the metropolitan area of New York City, Fiske (1984) reported that principals said that teacher resistance to training in computers was their major problem.

The existence of sex-role stereotyping attitudes regarding computers seems well-documented in research of computer usage. Yet, when the opportunity of computer classes was provided to both teachers and students in a southwestern community (S.D. Smith, 1984) there were no significant differences between males and females in attitudes of confidence about computer skills and ability. Equity of access to computers may be one way to overcome the negative effects of sex-typing attitudes. "Technophobia" and "computer anxiety" may yield, as well, to well planned programs provided for all students and teachers.

Generational differences between teachers and students should be acknowledged by those who are responsible for teacher training in computers. The ease with which many students acquire computer skills may be intimidating to teachers, as has been suggested in the previously cited research. Horror stories of computer inservice sessions for teachers conducted by "experts" abound. Perhaps the solution would be to have teachers and students sharing the learning process together. In their study of implementation of computer literacy, Hunter, et al. (1983) stated that teachers turned to students for ideas and information about computer related activities.

The hope that computers and technology can become a part of "teaching to potential" should be no less bright with the acknowledgment that there are negative attitudes among teachers about computers. Positive attitudes of enjoyment, educational computer support, and confidence in computer skills and ability seem to grow with opportunities to acquire computer literacy. There are many challenges on the road to becoming a computer literate educational community.

There is a need for more research to substantiate the existence of the computer attitudes which have been suggested, and to examine their relationship to teacher and student behavior. Research on teaching in higher education has not dealt with computer attitudes in university-level teaching. However, the definitions of computer attitudes and the reports of research related to computer attitudes which are examined in this paper have strong implications for university teaching. All the attitudes addressed in this paper (enjoyment, efficacy, educational computer support, technophobia, computer anxiety, sex-role stereotyping, age-related attitudes, and resistance to educational innovation) certainly exist at the university level. Not only those engaged in teacher education, but faculty in all areas of university teaching must be concerned with these computer attitudes if the promise of educational technology is to be realized, and "teaching to potential" will be an attainable goal.

References

Anderson, R.E., Klassen, D.L., Krohn, K.R.,and Smith-Cunnien, P. (1982). Assessing computer literacy. Final report of the National Science Foundation sponsored project: Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment. St. Paul, Minn.: Minnesota Education Computing Consortium.

Fiske, E.B. (1984). Computers, in most schools have brought no revolution. New York Times (December 9, 1984), 1, 34.

Gilliland, K. (1984). EQUALS in computer technology. The Computing Teacher. II (8), 42-44.

Hunter, B., Dearborn, D., and Snyder, B. (1983). Computer literacy in the K-8 curriculum. Phi Delta Kappan. 65 (1), 115-118.

Jackson, P.W. (1977). The way teachers think. In The Social Context of Learning and Development, J.C. Glidewell, ed. New York: Gardner Press, Inc.

Kiesler, S., Sproul, L., and Eccles, J. (1983). Second class citizens. Psychology Today 17 (3), 40-49.

Manning, A. (1984). Why aren't women hacking it? The computer gender gap. USA TODAY (October 16, 1984), 3D.

McPhee, J. (1966). The Headmaster: Frank L. Boyden of Deerfield. New York: Farrar, Straus, and Giroux.

Miura, I.T., and Hess, R.D. (1984). Enrollment differences in computer camps and summer classes. The Computing Teacher. II (8), 22.

Papert, S. (1982). Computers are objects to think with: an Instructor interview with Seymour Papert. Instructor. 65 (5), 86-89.

Porter, T. (1984). Reassuring the technophobe. Texas Humanist. 7 (1), 30-33.

Smith, S.D. and Smith, W.D. (1984). Hardware/software and hard times, Educational computing and curriculum change. Action in Teacher Education. V (4), 28-34.

Smith, S.D. (1984). How do you feel about computers? Computer attitudes related to grade level, sex, and teacher influence, unpunished paper, University of of New Mexico, 1984.

Stevens, D. (1984). Microcomputers: An educational alternative. Action in Teacher Education. V (4), 53-57.

Widmer, C. and Parker, J. (1983). Microanxiety: How to beat it before you get it. Electronic Educator. 3 (3), 23-27.

Winkle, L. W. and Mathews, W.M. (1982). Computer equity comes of age. Phi Delta Kappan. 63 (5), 314-315.

INSTRUCTIONAL TELEVISION FIXED SERVICE: THE CHALLENGE TO EDUCATIONAL INSTITUTIONS

by

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The Federal Communications Commission originally set aside twenty-eight channels for operation of Instructional Television Fixed Service (ITFS) systems. Many of the original 82 channel approvals were granted to PBS stations seeking to expand educational programming for colleges and universities, secondary schools, and nonprofit organizations. The new use of the channels (most of which fall in the 2500-2690 megahertz band), was designed to interconnect PBS microwave transmitters into a National Narrowcast Service. Between 1980 and 1983 the F.C.C. opened the channels for other uses, and included provisions for smaller applicants to enter into "lease agreements" with outside commercial interests for excess channel capacity (F.C.C. General Docket No. 80-112).

The Commission's proposal prompted sharp criticism from several nonprofit sectors who suggested the agency had given into commercial interests whose only programming ambitions were to increase pay movies, televised sports, and video games. This issue, still facing the F.C.C. in its approval of low-power licensees, requires determination of an applicant's desire for income versus serving the public's interests.

In the period subsequent to Docket No. 80-112, a number of universities, colleges, and nonprofit groups sought approval of I.T.F.S. operations. Many commercial groups, likewise, saw an inexpensive opportunity to get into the "narrowcast" business, and to compete directly with local cable and subscription television services. A number of the applications received by the F.C.C. included program schedules and financial agreements combining the instructional interests of the proposed licensee with entertainment programming provided by the commercial leasee.

The volume of applications filed on behalf of those wanting low-power approval was simply more than the F.C.C. could accommodate (4-6,000) by most estimates). While local applicants were supposed to be favored, the list included 150 proposals filed on behalf of Sears, Roebuck, and Company, and over 100 applications from Microband, currently the country's largest low-power television operator.

This paper examines the proposal of an I.T.F.S. facility, specifically that proposed for operation at the University of Colorado at Colorado Springs (UCCS). The reader will be briefed on the issues and decisions facing institutions desiring such a system, from its conception to operation.

The University of Colorado at Colorado Springs is one of three branch campuses of the University of Colorado system, and is located in an area of concentrated high technologies. Because of expanding activities in the electronics, computer science, and aerospace industries of the Pikes Peak Region, there exists a pressing need to provide information and instruction in engineering, business, and the liberal arts. Demand for the live and/or videotaped delivery of telecourses is growing steadily, and in an effort to meet these educational needs, UCCS has applied for approval of four channels on the low-power television bandwidth.

The advent of technology in education is not new. The hardware for low-power television has been successfully utilized, for purposes other than I.T.F.S., for over twenty years. As the demographics of college-student populations change, economic and social forces place the new technologies squarely in the forefront for delivering information.

The Carnegie Commission on Higher Education forecasts that by the year 2000, eighty percent of all off-campus instruction will be delivered by the new information technologies. The number of persons who could benefit from the new I.T.F.S. systems is enormous, and includes:

- Those wanting to meet requirements for lecensure, certification, or post degree credit;
- Those wanting in-service professional upgrading and continuing educational credit;
- Those seeking professional and vocational retraining beyond entry-level preparation;
- Those needing college preparatory skills in basic education, testing, and application procedures;
- Those wanting cultural enrichment in the humanities, arts, and sciences;
- Those wanting public information--general survival knowledge.

Unfortunately, many of the colleges and universities who could well utilize these capabilities cannot afford the allocation of resources necessary for I.T.F.S. operation. In the light of this realization, the F.C.C.'s Docket 80-112 has opened a number of opportunities and an equal number of tough choices regarding financing, programming, and operating such a system.

These choices are often resolved by difficult negotiations between the university's existing media support groups, its administrators, and outside commercial interests. The negotiations begin with the earliest envisioning of the system, and include:

- Constructing and equipping the I.T.F.S. transmission facility;
- Contracting and arranging for payment from outside interests;

- Operating, programming, and budgeting of the system;
- Marketing the telecourse options;
- Copyright considerations and faculty compensation.

Organization of the I.T.F.S. facility offers several options to the educational institution, a few of which follow. The institution may elect to construct, operate, and maintain all origination points, transmission facilities, and on-site receivers. Or it may simply serve as a programming source, leasing time from an outside entity which handles all aspects of transmission and reception maintenance "above the ceiling" of the origination point (e.g., the TAGER system at SMU). Finally, an institution may enter a "consortium" or "networking" agreement, wherein several agencies or institutions operate their own origination and delivery systems, and pool programming and distribution resources to create a network.

In the process of considering a system at UCCS, all three were considered, each offering unique advantages and drawbacks. Initially, the central administration of CU-Boulder began efforts to inter-connect the three university campuses along the front range via microwave. The system called CATECS (Center for Advanced Training in Engineering and Computer Sciences), included capabilities for video courses originating from each campus to be received at the other two campuses, thus serving clients in all areas affected by the inter-connect. Each campus would be capable of originating, transmitting, and receiving classes simultaneously. (Requirements for the system are stated here only conceptually, with a cautionary note to the reader that designing and engineering this type of system is extremely complex, and well beyond the scope of this discussion).

During discussion of the University-wide inter-connect, UCCS was approached by two outside commercial interests, each wanting to lease excess channel space for entertainment programming. In the negotiations, it was agreed that whichever outside agent UCCS became involved with, that agency would construct and maintain all transmission facilities in return for programming time. In these proposed agreements, the principle disadvantages to the institution included:

- The long term of the lease: ten years initial and ten years renewable;
- Possible public backlash over the program content aired on UCCS channels during non-I.T.F.S. hours (i.e., R- and X-rated movies and features);
- Possible discontinuance of the lease agreement by the leasee, leaving UCCS with I.T.F.S. broadcast commitment, and no operational monies;
- Possible political problems in an outside company competing with a local cable firm on UCCS channels.

Despite efforts on behalf of both parties, no agreement was reached between UCCS and an outside commercial interest. However, from these negotiations, two things became quite clear. First, programming an I.T.F.S. channel for five broadcast days per week would be difficult, but programming four such channels would be nearly impossible on the monies being discussed. Secondly, the interest in UCCS's low-power allocations was very intense from commercial interests, and the necessity for gaining construction approval was immediate. Regardless of whether UCCS entered into agreements with the firms initially contacting the institution, or with no outside agencies at all, UCCS administrators decided that obtaining the channels was vital.

Arrangements began along the lines of the first organizational option mentioned--proposal of a system on behalf of UCCS solely, and including construction, operation, and maintenance of all origination and transmitting facilities on the UCCS campus. A later compromise involved the Colorado Department of Telecommunications (an agency of the state government), preparing the application in return for tower space to operate its state-owned weather and police radio systems. In this, UCCS had accomplished two objectives: getting its application before the F.C.C., and maintaining relative autonomy over its educational programming and operations. The system proposed contains all of the elements of that being previously considered with the outside commercial interest, and allows for future inter-connection with the CATECS system.

Once the application was proposed to the F.C.C., it became necessary to return again to issues of operation and budgeting. UCCS had lost (immediately at least), one of its only sources of revenues--channel leasing, and now operating the system became UCCS's responsibility once again. Expense estimates vary for construction and equipment ($15-150,000 by central administration and Department of Telecommunication estimates); and upwards of $70,000 for equipment to originate programming.

It seems appropriate to mention a few things here about "programming" and economies of scale in the television industry. For the uninitiated, quality television programming, like quality education of any kind, is expensive. In this instance we are discussing quality programming of the information-intensive "talking head" variety, with visual support (i.e., on-camera notepad used by the instructor in the same manner as a blackboard). The origination point is not a studio, but a classroom equipped with cameras on remote-controlled pan-and-tilt units. The cameras are positioned to pick up the instructor's writing of notes, diagrams, etc., in an over-the-shoulder shot. This "candid classroom" approach has been used with documented successes in a number of instances, with the best designs incorporating two-way audio capabilities via phone lines from the remote site, and/or slo-scan interactive video set-ups.

What we are not discussing is the large budget "polished" look of productions commonly associated with the Children's Television Workshop (i.e., Sesame Street), or the Agency for Instructional Television (A.I.T.). Instead, the operative concept here is "currency" rather than aesthetics, and judging from existant research, there is indeed a thriving market for the kind of informational telecommunications offered by I.T.F.S. programming. This is not meant to imply that "quality" programming options are not available to the I.T.F.S. programmer; only that they are expensive and generally not the type of content that can be copyrighted and offered by a local university for credit. Program content of this upscale a production "value" will only be cost-effective to produce if it contains a correspondingly wide appeal (i.e., approximately $60,000 per disc for videodisc productions).

The economic decisions regarding the operation and budgeting of I.T.F.S. operations should be guided by the same criteria of accountability as those in any corporate media center--cost recovery.

Initially, the UCCS budget allowed for support positions to include operations, repair and maintenance, and support services. In the area of support services, a position was budgeted for faculty liaison to conduct training of faculty, scheduling the facility, and evaluating I.T.F.S. efforts. Another position (part-time at first), was scheduled for courier services. Future projections include a qualified instructional designer/developer to assist in optimizing faculty teaching.

Currently there are no projections available on estimated revenues from the UCCS system. However, the reader should be aware that many cost-benefits are realizable from the intrinsic benefit of being perceived as the most visible information source in a given market. The benefit of this perception can generate revenues for the university in more standard ways--enrollment increases, donations, grants, etc. In many cases, and UCCS was thus affected, the institution can ill afford not to get involved.

No discussion of operation and budgeting would be complete without considering the marketing aspects of an operation, and the marketing of an I.T.F.S. facility is vitally important. An analysis of product, price, promotion and purchase needs to be performed from a systems perspective. Effective survey research should be performed to determine which course options, release formats, and specific I.T.F.S. needs must be met in your area. Projections may indicate a decided preference for live programming, or videotaped materials in any of a variety of formats (Beta, VHS, U-matic). Survey research may indicate a need for strategically scheduling certain courses at specified times. These are issues of market demand, and failing to "target" your audience needs can mean investing monies and energies in options with little chance for success. It is the opinion of many in the low-power field that it is precisely this ability to narrow-cast that will determine low-power's possible future.

Similarly, measuring the effects of your I.T.F.S. efforts is important. This has traditionally been relegated to enrollment "head counts", number of courses offered, remote sites reached, and number of degrees granted. These are effective quantitative criteria to measure the "convenience" and efficiency of off-campus delivery systems, but are insufficient measures of the quality of instruction received. Some efforts are surfacing in the area of qualitative research (see AMCEE's evaluation of instruction instrument), but more are needed comparing telecourses with those conducted on-campus. This evaluation should be viewed as "on-going", as well as cumulative, and should be used to re-design or refine telecourse presentations. Cumulative statistics can be applied in judgments about those courses which are seemingly not well adapted to candid classroom delivery.

Final costs to users of teleresources should be budgeted on the cost of producing, duplicating, and delivering materials on-site minus standard tuition revenues. To recover additional capital and operating costs many I.T.F.S. facilities charge a teleresource fee to those receiving telecourse signals. This fee (sometimes as much as $2-3,000 per year), is oftentimes recoverable in the company's training and development budgets. The fee serves as an incentive for institutions to develop more on-site clients, as well as an encouragement for clients to make use of their

I.T.F.S. receiving system. Administrators who fail to budget for the training of operators, support/administrative services--marketing, courier, cataloging, and equipment depreciation, will cost their operation credibility and clients in the long run.

Recommendations for developing an I.T.F.S. operation in your institution begin with the establishment of a committee involving all potential users of the system. This committee should be notified prior to the first meeting, of information impacting decisions about programming, operations, evaluation, marketing, etc. This will enable a more parsimonious discussion and establishment of policy of the issues above.

The committee should set prices for live versus videotaped delivery, fees for eventual teleconferencing use, and establish long range plans in areas of budgeting, operations, and programming. The committee should be comprised of a representative number of faculty and administrators, and should seek to establish "fair" compensation for faculty participation in I.T.F.S. efforts. This committee will be instrumental in contracting with outside commercial interests wanting excess channel space. These negotiations should be guided by efforts to avoid those problems mentioned earlier in this paper.

Policies on faculty compensation should be guided by a thorough understanding of copyright legislation affecting the academician, and by allowing for off-loads and/or teaching assistance for those faculty with more than "standard" loads. As the faculty member is the owner and creator of the candid classroom "event", it is the opinion of this writer that the faculty member is entitled to some compensation from the outset as well as for the residual sale of the tapes.

The future of I.T.F.S. is dependent on the operational realities of budgeting, programming, etc., and on the technologies that will deliver this form of instruction in the future. Among the more crucial operational concerns in the future will be that of programming. The lease payments of outside commercial interests will not be adequate to sustain I.T.F.S. operations of the future. Systems will succeed or fail based on their ability to research and respond to local programming needs. Failure to meet this challenge will likely eventuate in nationally based programming organizations, like the National University of the Airwaves (NUA), and the National Technological University (NTU), consolidating the teleresource market. This consolidation would result in a national credit-granting institution, making local efforts to offer the same largely unnecessary. Feasibility studies for this type of operation and distribution are already underway, with many AMCEE institutions currently participating. A logical consequence of this would be for the "best" instructors in their respective fields to move to the national level of distribution, as has happened in the commercial radio and television industries.

Future programming concerns for I.T.F.S. operations must also take into account the nature of the typical I.T.F.S. program format, and the use of the typical telecourse on-site. "Talking head" television is the format most commonly associated with the failure of educational television in the late 1960's and 70's (among other reasons). While this is an arguable point, most would agree that unless programmers begin experimenting with alternative formats--those utilizing greater post-production (editing) and more visual variety, the talking head format, and thus, I.T.F.S. programming, could be in difficulty. A great deal of research supports the use of print materials and on-site tutors to augment I.T.F.S. telecourse efforts. Still more research shows the comparative effectiveness of computer-assisted (CAI) and interactive instructional television, combining the technologies of video-disc, personal computers, and advanced television production techniques.

In conclusion, whether a college or university gets involved with I.T.F.S. should be a committee decision. This decision should be based on solid researching of the local teleresource needs. If the decision is made for the institution to go ahead, the process of applying should begin immediately to avoid losing the channel allocation or potential lease agreements to other nonprofit groups. A number of experienced consultants are available to assist with the engineering application and technical requirements.

It should be decided early on if the institution wishes to enter a consortium. Based on market analysis, determine which courses will be offered, in what formats, and in what price range. Establish a means of recovering as many costs as are practical. Make the enrolling in courses as "user friendly" as possible, playing up the convenience of I.T.F.S. If it is decided to enter a lease agreement, avoid the pitfalls of long leases, laissez-faire agreements on programming content, and the lack of alternatives if the lease fall through.

Realize, and make others in your institution aware of, the limitations and "currency" of your candid classroom format. Discuss and encourage on-site use of tutorial assistance and supplemental print materials. Consider experimental projects utilizing more sophisticated production values.

Suggest that planning for I.T.F.S. operations begin well in advance of its "on line" use. Do not wait until the system is in place to find out what (or if) I.T.F.S. needs exist in the marketplace. Likewise, do not expect 100% realibility from the system once it is in place.

Evaluate the effects of your I.T.F.S. efforts quantitatively and attempt evaluation of the televised instructional materials against more traditional delivery systems. Finally, establish fair and equitable arrangements for compensating faculty.

It should be remembered that faculty time is a precious resource, oftentimes allocated among competing uses. When all technical requirements are met for I.T.F.S. operation, they will represent only the minimal criteria for low-power telecasting. The true measure of the I.T.F.S. system will be determined by the quantity and quality of program options, support services, and degrees awarded.

READINGS

Baldwin, L. V., "New Modes for Advanced Engineering Study," Engineering Education, February 1983, pp. 384-389.

Baldwin, L. V., and K. S. Down, Educational Technology in Engineering, National Academy of Engineering, National Academy Press, Washington, D.C., 1981.

Baldwin, L. V., "An Electronic University," IEEE Spectrum, November, 1984, pp. 108-110.

Botkin, J., et al., Global Stakes: The Future of High Technology in America, Ballinger, Cambridge, Ma., 1982.

Gibbons, J. F., W. R. Kinchelow, and K. S. Down, "Tutored Videotaped Instruction: A New Use of Electronics Media in Education," Science, Vol. 195, March, 1977, pp. 1,139-41.

Schmidt, A., "Low Power TV Applicants Line Up," Denver Post, August 28, 1983.

Walker, K., "A Comparison of Three ITFS Facilities," unpublished position paper-UCCS Media Center, April 6, 1984. Available from the author.

DON'T BOTHER ME WITH INSTRUCTIONAL DESIGN I'M BUSY PROGRAMMING!

Suggestions for more effective educational software

by

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DON'T BOTHER ME WITH INSTRUCTIONAL DESIGN I'M BUSY PROGRAMMING !

Suggestions for more effective educational software.

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A recent comment by Larry Lipsitz, the editor of Educational Technology Magazine, caused me to remove my PASCAL disk from my disk drive, to temporarily put aside my attempts at programming educational software and to boot my word processor and write a few comments about educational program design. "We publish very few instructional design papers anymore;" he said, "I think instructional design is dead!"

"Dead!" I exclaimed. "How can instructional design be dead? Hundreds of people, most of whom have never even heard of instructional design, are at this very moment sitting in front of their personal computers entering computer code to create educational software. Many of these programs have been, are being or will be reproduced and sold to unsuspecting parents, teachers and students. If these self-styled cottage-industry educational technologists are not engaged in instructional design what are they doing?"

Rather than being dead instructional design is undergoing a new birth. The academic approach of formal education is being challenged by creative ideas that are radically different from the past. The explosion of new software promises greater achievement than has ever before been possible.

However, for every effective innovative program that appears there also appears many programs that are innovative only because they are on the computer. These products frequently lack even the fundamentals of effective educational design. In this paper we will explore a few basic techniques of instructional design which are too often ignored by the developers of many of these new educational products.

The earliest educational programs were merely drill and practice and were little more than workbooks put on the computer. In fact some publishers did exactly that, put their already published workbooks on the computer. The result is a very dull program that may provide some skill development if the student already knows the material and if sufficient external reward or punishment can be arranged to keep the student at what otherwise is a very boring activity. Unfortunately many people still equate computer based education with such boring drill and practice programs. Advocates often cite the patience of the computer as a virtue of such programs. Little is said about the patience of the student.

Figure 1 illustrates a short sequence of such a program from a major publisher. There is no instruction prior to what is illustrated. After signing on, the student is presented frame A. The ? symbol is flashing. The student responds by typing in the missing number. If the student is incorrect frame B appears. The incorrect response flashes. After two incorrect tries the student is given the correct answer and presented the next problem. If the student is correct frame C appears. The cute graphic apple with the worm is in color and the worm crawls out of the apple. Pressing the return key gets the next problem. There are only three correct reward graphics. Frame D shows a dragon which breaths fire when the student is correct. The effectiveness of such reinforcers is quickly dissipated and the student is left with the boring task of doing one problem after another with nothing but right and wrong feedback. If the student does not know how to do the problem there is no remedial help, except to call the teacher. Ironically, this program is very expensive!

Too many educational product designers assume that their only responsibility is to provide opportunities for practice. In this author's opinion educational software should do more than merely present a workbook to the student. With the capacity provided by a personal computer courseware should provide not only opportunity for practice but information about how to perform the task as well. Adequate educational software should teach.

In this paper we shall review three classes of instructional design techniques that are necessary if educational courseware is to teach. These techniques can be grouped into those that affect three areas of instructional design: instructional strategy, screen design and human factors. Each of the techniques discussed will be illustrated by two versions of a program on poetic meter. The NOT-SO-GOOD version appears in figures 2 and 3. This is really a straw man program created especially to illustrate what not to do. Perhaps it resembles programs you have used. The second version (figures 5 through 11) is a commercial product designed by the author. In this product we have attempted to use most of the design techniques discussed. The displays included represent only a few of the displays in the program.

INSTRUCTIONAL STRATEGIES

This section identifies design strategies which are believed to have a direct impact on the amount of learning that occurs as a result of instruction. Instructional design strategy involves the arrangement of content elements and other information in such a way that learning is facilitated. In this section we have attempted to identify a few strategies which have been shown to enhance or inhibit learning.

Page Turning.

In the early days of educational television lectures were often put on the TV screen. The result was deadly. Today we have textbooks put on the monitor. Also deadly! If the monitor merely substitutes for a page of text there is little reason to put the material on the computer. Too many educational computer programs present a paragraph of text and then asked the student to press the space-bar or return key to continue. Continuing means to turn the page and see the next paragraph of text.

Many authors and instructors are accustomed to one-way linear presentations such as lectures and textbooks. In such presentations student interaction is seen as an interruption not an essential part of the presentation. As a consequence few designers conceptualize instruction as a conversation or if they do the input from the student seems to be of secondary importance serving only to indicate readiness to continue.

Look at figure 2. This represents the first few displays of the NOT-SO-GOOD poetic meter program. Frames A, B and C are consecutive; several displays are skipped between frames C and D. This is an example of the text-on-the-screen characteristic of too many educational software packages. A paragraph is presented and then the computer waits until the student presses the return key which results in another paragraph being presented. The material takes no advantage of the dynamic nature of the screen. As can be seen from the illustrations one paragraph scrolls up to make room for the next at the bottom of the screen.

To be effective educational software must be more than text on the monitor. There is no advantage to having students read text from a monitor which they can more easily read from the printed page. In short, **avoid merely putting text on the screen; avoid mere page turning.**

Generality-rich, example-poor.

Since, as an instructor, we usually understand what we are presenting there is a tendency to present one idea after another with little illustration. Illustrations and examples often seem to slow down the presentation. Text books often contain few illustrations because of the need to cover the subject matter in limited space. Adding unnecessary illustrative material "pads" the book making it unnecessarily lengthy and expensive. As a consequence of this disposition much of the CAI which has been prepared models lectures and textbooks rather than conversations. Ideas are presented one after another with little illustration and little opportunity for student interaction. As a consequence students do not have a chance to digest one idea before the next one comes.

Look at figure 2. Note that one idea tumbles after another each time the return key is pressed. In frame A the purpose of the lesson is stated but not illustrated. In frame B important prerequisite information is reviewed but not illustrated. In frame C three different ideas, stressed syllables, rhythm and poetic feet are each presented one after another without illustration.

Instruction is more effective if each major idea is represented by a general statement of the idea (generality) followed by examples and finally by the opportunity for the student to demonstrate that the idea is understood (practice). In short, **avoid generality-rich but example-poor presentations. Each idea should be presented by a generality, examples and practice.**

Remember Only.

Perhaps the biggest problem in all education is the tendency to tell the student something and then ask the student to repeat what was said rather than applying the idea to a new situation. It is easy to ask a student to repeat what has been learned but much more difficult to figure out how the student should apply the information. Application means that we must find specific cases which can be represented in our instructional materials and then we must figure out what the student does when he applies the information that has been presented. Furthermore all of us have had many examples of remember testing but many fewer examples of application testing. In formal educational settings we are accustomed to recall but not to application.

In figure 3, frames B and C, we see examples of remember questions. In these displays the student is asked to remember the definitions of each kind of meter. If the student is right the next question is presented; if wrong a message instructs the student to try again. The try again message is repeated until the student stumbles onto the correct answer. Too often this is the only kind of practice that is provided for the student. However, in the NOT-SO-GOOD Poetic Meter program the student is also ask to apply the definitions by identifying the type of meter involved in a series of words (See figure 3, frame D). A running total indicates how many the student correctly classified.

Too often educational products neglect having the student apply what has been learned. Or if there is application it is insufficient to allow the student to demonstrate what has been learned or for the designer to determine if the student has learned what was taught. Instruction is more effective if the student is required to apply ideas to new situations rather than merely repeating the statement of the idea. In short, **avoid remember only practice.**

Attention focusing.

Not all communication is designed to be instructional. One of the things that characterizes instructional communication is the addition of information that is not part of the subject matter but which is included to help the student understand the subject matter content. Text books use headings, bold face lettering, italics, arrows, exploded drawings and many other devices to facilitate the student's understanding of the content presented. This attention focusing information should serve two primary functions: first, it attempts to relate the illustrations to the generalities being taught and second, it points out the critical characteristics of the example being presented.

Computer displays have a wide variety of display characteristics which can be used for this attention focusing function. All of the characteristics of text presentation are also present on computer displays. For example, words can be underlined, appear in bold face, italic or other type styles. The display can include color which can be used to tie ideas together or emphasize important portions of the display. In addition, however, there are many dynamic characteristics of the computer display that are not available in print. These include: timing where text is put up a little at a time for emphasis, animation where text or figures are moved about to show relationships, flashing or inverse text which can direct attention to a given portion of the screen, sound which can attract attention or show patterns in the presentation.

Too often these characteristics are used for entertainment and have no instructional function. Putting text up letter by letter, word by word or moving across the screen like a sign may be clever but often only serves to make the text harder to read. Having the computer beep when text is entered or displayed often does little more than disturb others in the room. Colorful displays that show rainbow patterns of text or figures too often are only aesthetic and distract from the purpose of the instruction. If these devices are used they should serve an instructional purpose. If they do not they may prove to be more of a distraction than a facilitation.

Look at figure 1 again. The animated figures used for reinforcement are entertaining the first time they appear but they have no instructional value over that of saying, "You are right". They do not show the relationship between an example and a generality nor do they focus the students attention on relevant aspects of the examples.

Look at figure 4. This is a short sequence from another commercial program on fractions. (Edu-Ware) In frame A an animated figure pulls the shading from the first box across the screen to the second box (frames B and C). After moving the shading the figure walks to the bottom of the screen (frame D) to point to the symbolic equivalent of what has been done. This enables the student to visually and dynamically see that 1/2 is equal to 2/4. In this sequence of frames the animation directs the students attention to relevant characteristics of the display and helps the student understand the relationships involved. The animation is not only relevant but probably shows relationships that would be difficult to explain with words or symbols alone.

Look at figure 7, frame A. The directions at the top of the display indicate that the student should, "Listen to this passage." The syllables of the poem are then displayed one by one. Each syllable is accompanied by a tone. Stressed syllables are accompanied by a high tone whereas unstressed syllables are accompanied by a low tone. In this way the student can hear the stress pattern in the passage while seeing the passage displayed. Again the sound is used in an instructionally relevant way to direct the student's attention to the critical characteristic of stress.

The computer provides a considerable arsenal of display possibilities. If these devices are used to focus the student's attention on critical aspects of the subject matter being presented then they can substantially facilitate the learning which occurs. If, however, they are used indiscriminately merely to be clever without a clear instructional intent they may distract from, rather than enhance, the learning which may occur. In short, **use attention focusing devices to relate examples to generalities and to point out critical characteristics of the illustrative material.**

Active Mental Processing.

In an attempt to promote interactive instruction as opposed to linear presentations the early advocates of programmed instruction recommended that students should be required to respond overtly to the material being presented. Attempts to demonstrate the effectiveness of overt responding often were disappointing failing to show a distinct advantage for programs which required overt responses versus those which did not. More recent research has shown that it is not just overt responding that is important but the degree to which the student is required to mentally process the information which is being presented. Effective instructional conversations must engage the student in a way that requires thinking about the important aspects of what is being presented rather than passively observing information on the screen.

One of the techniques which promotes active mental processing is the use of rhetorical questions. A rhetorical question is one which is used to emphasize a point or introduce a topic and for which no answer is really expected. The advantage of using rhetorical questions rather than statements is that the student is more likely to engage his or her mental processes in formulating an answer rather than passively processing a statement. Then when this answer is confirmed by the presentation the point is more likely to be remembered.

Compare figure 2, frame B, with figure 6, frame A. The NOT-SO-GOOD program makes a simple declarative statement about the role of rhythm in distinguishing prose from poetry. The other program makes this same point but does it with a series of rhetorical questions ending with a rhetorical question which requires the student to actively engage in the conversation. The program does not wait for an answer to the first two questions:"What makes a poem a poem?" "Why is a poem different from prose?" The purpose of these questions is to cause the student to think about what they already know thus activating their mental processes so that when the point is made that one of the primary differences is the rhythm pattern they are anticipating this information and thus more likely to remember the point.

A related technique for promoting active mental processing is to engage the student in a conversation about the topic. Many educational programs use multiple choice questions as a way of interacting with the student. From a programming standpoint such questions are much easier to evaluate. However, in a conversation we are not interested in evaluating the students answer anyway. The questions we ask or the response we prompt are another form of rhetorical question. We request an answer but the purpose is not to see if the student knows what we have said or is able to give the correct answer but rather the purpose is to cause the student to think. If the comment made by the student is something we anticipated we want to acknowledge that the student is thinking consistent with our intent. If on the other hand the student provides some statement that we have not anticipated we carry on much like we do in live conversations when we do not understand, that is, we merely restate our point with the hope that the student will then see where we were going. We do not say, "That is wrong!" or "I do not agree." We merely continue with the conversation.

Again compare figure 2, frame B, with figure 6, frames A through D. In figure 6 frame A we anticipate that the student will make a response to the third request and the program provides a cursor to indicate to the student that we anticipate such a response. The program is written such that the student can type anything as a response. If the student is following our conversation, and is serious about interacting with the program, it is very probable that the response will be rhyme, since that is the most widely known characteristic of poetry. The program anticipates this response, including a dozen different ways to spell the word (rime, rhime, etc.). In response to this input from the student the program displays the information in frame B by acknowledging the students input and suggesting that there is yet another characteristic which we are thinking about. If the student anticipates our intent and responds with meter, beat or rhythm (including likely misspellings) the program responds with frame C. If the student should respond with meter or rhythm to the first question the program displays frame C instead of frame B. Finally the program displays frame D which now makes the point in a declarative statement. If the response to either the question on frame A or frame B is unanticipated the program responds with frame D. The result of this conversational programming is that the student has the feeling that the computer is really carrying on a conversation rather than merely presenting information. Furthermore, the student is being required to think about the idea being presented.

Other examples of this conversational approach can be seen in figure 7, frames A. In this frame after presenting an example of poetry and an example of prose the student is asked to observe the difference. Our conversation anticipates that the student will observe the regular pattern of stress or meter. The program anticipates a wide range of key words expressing this idea. If the student uses any of these key words in his or her response the program acknowledges with a simple, "Yes, passage 1 has regular or steady rhythm." If the student does not anticipate a key word then the "yes" is dropped from our reply but the rest of the statement is presented. The program then asks the student about passage 2. The conversation continues in this same way.

Figure 7, frame B provides yet another example of conversational programming. The program asks the student, "What is a stressed syllable?" Many students reply, "One which is stressed." This response does not go beyond the question so the program asks, "Can you think of another word?" If the student anticipates loud, emphasized, higher or synonyms of these words the program acknowledges with, "GOOD!" and the statement indicated on frame B. It should be noted that all of the displays are dynamic and the pieces shown come up one at a time so the second part of this display showing the passage of poetry actually appears after the student has been asked to read the passage aloud. Then the passage is chanted with sound enhancement to allow the student to compare his reading of the passage with the programs version of stressing the syllables.

Educational software should be conceptualized as a conversation rather than a lecture or a book. The interaction with the student is far more than merely asking the student if he or she is ready to continue. The interaction should not be limited to asking the students questions for the purpose of seeing if they know the "right" answer. Rather the purpose should be to stimulate thought and actively engage the student in an interchange which will lead the student to understand what we, as an author, are trying to teach. In short, **promote active mental processing by asking rhetorical questions and engaging the student in a conversation which requires constructed (as opposed to multiple choice) responses to which we do not provide right-wrong feedback but rather an anticipation of a reasonable reaction much like that which would be expected from a live conversation.**

Examples.

All of us know the cliche that there is nothing that teaches like a good example. For some reason the cliche has not found its way into the rules for effective educational software. The most common approach for tutorial programs is to immediately begin to ask the student questions, not of the rhetorical type discussed above, but questions testing the content which is being taught. If the student is uncertain about the content this approach often causes anxiety because the student does not know how to answer the question and being required to respond with the "right" answer when a student knows that he or she does not know causes frustration. Most educational software would be improved if the ideas were illustrated for the students by means of expository examples which show the application of the ideas being presented. Then, after the student has had an opportunity to study these worked examples, practice in applying the ideas is less threatening and more likely to be productive in promoting acquisition of the necessary skills.

The NOT-SO-GOOD poetry program moves immediately from a page turning presentation of ideas to a series of questions asking the student to remember these ideas and then to a series of questions asking the student to apply these definitions to new words without seeing any examples prior to this practice exercise. This is not atypical of many educational software packages. In the improved version of poetry figure 8, frame A shows one form of example presentation. The student has the opportunity to examine as many words of each type of meter as he or she feels is necessary to understand each of the meter types. Pressing the space-bar moves the pointer from one box to another. Pressing the return key causes the example word or phrase to appear in the box together with sound enhancement showing the stress pattern.

Figure 9, frame A shows a similar display for practice. After the student has seen as many examples as the student feels are necessary he or she can request the practice display by pressing the escape key. In this practice display words are presented one by one. The student uses the space-bar to point to the correct meter type. This is a form of multiple choice question. Note that in practice the intent is to determine if the student has mastered the concepts being taught. This display differs significantly from the conversational displays that were used to teach the ideas in the first place. If the student answers wrong the display indicates that the student is wrong, points to the correct answer and chants the word or phrase.

A similar set of example and practice displays are used for whole verses. The student is shown a passage of poetry. The dynamic display then shows the student how to divide each word into syllables, which syllables are stressed, where the poetic feet are divided, how the poem is chanted and finally the type of meter involved. After examining as many of these expository examples as the student feels is needed to understand each type of meter a series of practice verses are presented to the student. After the student has classified each verse the option is given to do a detailed analysis of the verse.

Too often educational software moves immediately from the presentation to the practice without presenting illustrative examples of the ideas being taught. Students are able to learn more efficiently when they have the opportunity to study examples of the ideas prior to being asked to practice applying the ideas to new examples. In short, **provide expository examples as well as practice.**

SCREEN DISPLAY

This section identifies screen display techniques which are believed to facilitate the students ability to interact with the materials. Screen display refers to the way that information is exhibited on the monitor. In this section we have attempted to identify a few display characteristics which may enhance or inhibit learning.

Scrolling.

One of the advances in computer technology was the ability of a computer display to scroll material automatically as the text being entered reached the bottom of the screen. For many applications such as programming or word processing this automatic scroll is a real advantage which eases the users task in entering material into the computer. However, what is an advantage for some applications is a disadvantage for others. When a student is trying to read a display it is very distracting if the text jumps up to the next line or worse jumps up several lines. The student loses his or her place and must then reread the material to find where they were. This interruption causes a distraction which often interferes with learning.

Students often use the location on the page as a cue to what was read. When reviewing material we often remember where it was on the page and use this spatial information to help us remember the content. When a page of text scrolls the material appears at a different place on the screen each time it is seen thus eliminating this spacial cue which often assists learning.

Look at figure 2 again. The displays shown here illustrate scrolling. When the return key is pressed the material on the screen jumps up line by line as the new material is being written at the bottom of the screen. The student must read the text as it jumps or wait until the whole message is written before reading the screen. Also when the scrolling stops what was just read now appears in whole or in part at the top of the screen and the new material appears at the bottom of the screen. The student may be confused about what has been read and what is new.

While scrolling is an advantage for word processing, programming and other applications it is usually a disadvantage for educational programs. There may be some situations where it has an instructional purpose but usually it is an unnecessary distraction and should be avoided. In short, **no scrolling for educational programs.**

Text Output.

In a text book the page is already filled with text when the student opens the book. With a computer display the text is written on the display before the student's eyes. Unimaginative programs often model the book and place a whole screen full of text up at once so the monitor resembles a page of text. Merely placing text on the screen ignores the dynamic character of the computer screen and the possibilities for using text output to enhance the instructional effectiveness of the presentation.

One of the dangers of the dynamic display of text stems from the fact that students read at vastly different rates. When the text is removed from the screen under program control there is a danger that the student has not yet finished reading the message. This is like reading a book with someone who reads faster and having them turn the page when you are still in the middle. When the text is removed before the student has finished reading the resulting confusion and frustration considerably inhibits learning. It is a good idea to allow the student to indicate when he or she is ready to continue (a good aspect of the "please press return to continue" message). Or, when text is removed by the program there should be some means for the student to retrieve that which was removed.

Look at figure 7, frame D. This is a dynamic display which presents the information a little at a time with a slight delay between each new part. The title comes up first, "FOUR KINDS OF POETIC FEET", followed by a 2 second delay. Then the four boxes appear. The headings are written one by one: "first syllable stressed", delay, "last syllable stressed", delay, "two syllables", delay, "three syllables", delay. Then the names of the four types of meter appear one by one: "TROCHAIC", delay, "IAMBIC", delay, etc. Then each type of meter is illustrated. The name is repeated, "TROCHAIC" with the definition, "2 syllables, 1st stressed". Then the direction, "LISTEN" flashes a few times along with the arrow pointing to the lower box. Finally an example word is placed in the box one syllable at a time while the stress is indicated by sound. After a delay of a few seconds the next type of meter is shown in the box until each of the four types have been illustrated. Examples of the different types of meter are presented and removed under program control. What if the student has not finished studying one type before the next appears? After all four types of meter have been illustrated a black stripe appears at the bottom of the display like the one shown in frame B. The directions, "[RET] REPEATS" means that pressing the return key will repeat the entire dynamic display again. In this way the student can control the text output even though individual elements are under program control.

For very short messages it is not necessary to provide means for the student to repeat the text presentation. For example, look at figure 9, frame B. When the student chooses the wrong type of meter the program displays the message, "WRONG" and shows an arrow pointing to the correct choice. Then the program chants the correct version of the word. The program then goes to the next word. The feedback information is presented under program control. In this case allowing the student to tell when to remove the "WRONG" and go on requires an unnecessary response on the part of the student since there is no difficulty in understanding the feedback message.

Computer displays, unlike text, can use the dynamic presentation of text and graphic material to focus the student's attention and facilitate learning. However, if critical text is removed before the student has had a chance to finish studying the information the result is frustration and interference with learning. A means should be provided for the student to indicate when he or she is ready to continue or for repeating information which is presented under program control. In short, **the student should control text output. Never erase critical information until the student indicates readiness to proceed OR provide a way to repeat dynamically presented information.**

Dynamic Displays.

Unlike a page of a text book a computer screen is a dynamic medium. We have the added dimension of time which allows text to be displayed or erased at will. Furthermore text can be black-on-white or white-on-black (inverse). Text can flash. Text or graphics can be animated and be moved about the screen to show relationships. Too many educational programs assume these features are only for arcade games but do not take advantage of them for tutorial programs. These dynamic characteristics, when used in an instructionally relevant way, can do much to increase the effectiveness of the instruction.

Timing of text output can be used for stress or to improve readability. In frames A and B of figure 7 the stress patterns in poetry and prose are indicated by displaying a passage syllable by syllable where each syllable is accompanied by a high sound when stressed or a low sound when unstressed. Frame D used timing to emphasize the attributes of the various kinds of meter. Rather than putting the entire diagram up at once the attributes are put up one by one with a pause between so that the student will focus his or her attention on the attributes one by one. The names of the kinds of meter are displayed one by one so that the student will focus attention on each name as it appears. This timing of text output makes the presentation more easily understood because the student's reading pattern is directed rather than left to chance.

Flashing text can also be used to direct attention and prepare the student for that which is to come. Look at figure 7, frames C and D. In these frames examples of the different types of meter are presented to the student one after another. If the words appeared without the direction to listen the student would not be prepared and would likely miss the use of sound to show the stress pattern. In this display the word, "LISTEN", and the arrow pointing to the box where the words will appear, flash for a second prior to the word appearing. In this way the student is anticipating the sound and the word when it appears.

If there is not an instructional purpose the use of these dynamic characteristics can be very distracting. Text which flashes or animation which occurs with no apparent purpose distracts rather than enhances learning. Look at figure 1. The cute cartoon characters which are used to indicate a correct answer soon lose their value. On the other hand the animation which occurs in figure 4 enhances the idea which is being taught by directing the students attention to the critical aspects of the display.

Computer displays, unlike textbooks, can be dynamic. Timing can be used to direct reading behavior, direct attention to particular portions of the screen or to stress certain ideas. In short, **use dynamic displays in which timing of text output, inverse text, flashing and animation are used for stress and emphasis.**

Display Planning.

When text books are put together a graphic designer often lays out the pages for aesthetic appearance and consistency. Effective layout can greatly facilitate the learning which can occur from the printed page. Too often, with computer displays, the need for graphic design is overlooked because the production process is simplified and steps which are usual in the production of books are eliminated. As a result too many programs look like rough drafts of printed material rather than carefully planned displays.

The screen should be planned as a unit. Each element, whether letter, word or graphic, should be carefully placed on the screen at the location that the designer selects. Furthermore the designer should have a purpose for placing information on the screen. If this purpose is aesthetic more pleasing appearing displays will result. If this purpose is instructional as well as aesthetic more learning will result. Following are a few characteristics of good screen design which should be considered. There is space here to identify only a few of the elements of good screen design.

Dark on light. The nature of a cathode ray tube makes turning on dots the natural way to write to the screen. Hence white (or lighted) letters on a dark screen became the norm. After one has worked at a cathode ray tube for many hours lighted letters and a dark screen began to appear as normal. However, for a student who may be learning from a computer for the first time light letters on a dark screen seems very unnatural. They are accustomed to seeing dark letters on a white page. Consequently it may be more desirable to paint the screen light and cause the print to appear as dark letters on a light screen.

Look at figures 1 and 2 which use light letters on a dark screen. Does this seem confined or closed in? Now look at figure 6 which uses dark letters on a light screen. This gives an open less restrained feeling. Which appears more natural? It should be noted that for clarity on the printed page some of the NOT-SO-GOOD poet program (figures 2 and 3) were printed in inverse. That is, the program used light letters and figures on a black background. We feel these programs would be easier to read if the programs used the black-on-white appearance of the printed page as they appear here. In short, **dark letters on a light screen will appear less confined and more natural to the student.** It is interesting to note that the new APPLE Macintosh uses dark letters on a light screen.

White space. Printed media has cost. A book of 100 pages costs more for materials than a book of 50 pages. To conserve costs (not to mention ease of use) printed materials try to put more on the printed page. In fact, because of some unscrupulous home study businesses, the postal service has standards about how much print must appear on a single page of instructional material sent through the mail. It is unlawful to send materials through the mail that does not meet this minimum. You cannot make the materials look to be more by putting fewer words on a page. A computer display on the other hand is free, that is, 20 displays cost no more than 1 display in terms of paper. Hence there is no good reason to fill the screen with text. Conversely there are often good instructional reasons to display only what the student needs at a given time on the screen. After a given piece of text or graphic has served its purpose it should be removed. Leaving it on the screen merely clutters the display with unnecessary and possibly distracting information.

Look at figure 2. Each of the screens are busy and full of text. Rather than inviting the student to read them they seem to promote the feeling, "Do I really have to read all that text?" Furthermore, after the student reads the first paragraph it (or worse, part of it) remains on the screen. This is unnecessary information which merely fills the screen and makes it more difficult to find the new paragraph.

Contrast the displays in figure 2 with the displays in figure 6. In figure 6 the displays were carefully planned and sentences appear only where the designer intended for them to appear. There is plenty of white space between sentences making them easier to read. In contract, the displays in figure 2 were determined by the built-in computer functions of word-wrap at the end of the lines and scrolling. The author merely entered the information and let the computer determine the display. In short, **leave plenty of white space and erase information when it is no longer needed.**

Short lines and natural phrases. In the early days, before 80 columns were common place, I have often heard designers of educational software complain that there was not enough space on the screen. Only 24 lines of 40 characters seems very confining when we are used to up to 60 lines of from 70 to 80 characters. However, the discipline of stating things more concisely may actually improve the instruction if each of the ideas to be presented are carefully considered and the words carefully chosen. When, as a designer, you realize that it is not necessary to start every line at the left margin and fill to the right margin then you begin to realize that the placement of text on the screen can actually enhance comprehension. Since we are no longer constrained to use the page economically we are free to use the layout to convey the message that we are trying to present.

Look at figure 7, frame B. Notice the response supplied by the computer to the rhetorical question, "What is a stressed syllable?" The stem of the statement is on the second line, "A stressed syllable is". Then each of the important ideas are expressed one per line, "louder", "emphasized", "higher in pitch". This listing tends to emphasize the individual characteristics so that they are not lost in a long string of prose. A similar use of short lines with a single natural phrase on each line is illustrated in the last part of this same frame. The stem of the statement is on the first line, "Stressed syllables are". The two ideas related to stressed syllables are emphasized by placing each on a separate line and indented from the stem, i.e., "higher in pitch" and "often found by reading aloud". A similar use of short lines with one natural phrase or idea per line is illustrated in frame C of this same figure. The stem appears on the first line, "A POETIC FOOT is". The characteristics are separated with one idea to a line and indented considerably, "a group of 2 or 3 syllables", "where 1 syllable is stressed", " and 1 or 2 are not stressed."

The poetic meter program sometimes does not use complete sentences when the idea can be presented with a list of abbreviated phrases. Some educators feel that educational software should demonstrate "good language use" and should therefore avoid sentence fragments and other incorrect usage. The use of short lines where one phrase appears per line can still be used as illustrated by frame. In short, **use short lines and separate natural phrases or ideas on each line.**

Fill justify. The thing that impressed me most when I first started to use a word processor was the fact that by merely giving a simple instruction I could have my document printed with right hand justification as well as left hand justification. The resulting document looked so professional, almost like it had been printed by a press. It has since come to my attention that some research has shown that a ragged right edge is easier to read. In fact the aesthetics of straight margins on both sides of the page may be detrimental to learning. What looks nice when a page is opened may in fact make it harder for the message to come across. If this is true for the printed page it is even more true for a computer screen. In short, **don't fill justify text on the screen.**

Upper case. In the early days of personal computers machines appeared which had no lower case alphabet. Many programs developed for these early machines were done in all upper case letters. Unfortunately, the BASIC programming language that still exists on many machines will allow lower case letters only with some difficulty. As a result it is sometimes easier to program in all upper case. However, the data shows that children often use the shape of the word as a cue to its meaning. When words appear as all upper case this cue is gone and reading becomes more difficult. There is no real excuse for professional programs to use all upper case and there is considerable evidence that all upper case presentations are more difficult to read and comprehend.

An isolated word or title in all upper case tends to make it stand out and is one form of creating emphasis. The use of all capitol letters for emphasis probably enhances the instructional impact and is desirable. But if all the letters are capitols this emphasis is lost. In short, **do not present information in all upper case except for emphasis.**

Text style variety. The printed page is often made more pleasing by the inclusion of different styles of text. If this use of text style is haphazard and not related to the instructional purposes of the presentation it is probably distracting. On the other hand use of a different style of text can enhance the presentation if it is used for emphasis or to indicate that the text appearing in the new style has a different purpose. Newer personal computers allow different text styles on the screen even for ordinary document creation.

The examples included with this paper have not made wide use of different text styles except the use of inverse (technically reverse inverse). In figure 7, frame A the passages are shown as white-on-black to set it apart from the instructional text which is black-on-white. This is consistent throughout the program. All of the sample words and poetry is shown inside a black box as white-on-black. This helps the student to find the illustrative material and separate it from the instructional text. In short, **use a variety of text styles to indicate a different kinds of messages.**

HUMAN FACTORS

Human factors refer to those characteristics of the software that make it easy for the student to use. The difficulty of using many computer programs has become recent folklore. It is frequently necessary to memorize a long list of control characters or other commands in order to interact with the program. The most recent advances have attempted to deliver software that requires little or no knowledge of computers; software with which the user can interact by pointing. In this section we have suggested some of the human factor concerns which will make educational software easier to use and thus result in more efficient learning.

Control of location.

Many educational programs have the characteristic of an adventure game. The student has wondered into a maze and cannot see the way in or the way out. The only choice available is to keep working in the hope that the light at the end of he tunnel will soon appear. The problem with this approach is that the student may find that he or she already knows what is being presented and would like to skip ahead to the next section. Or, worse, the student is having difficulty and would like to return to a previous section. Many students have learned that a quick survey through the material before beginning more serious study greatly facilitates the ability to integrate the new information with that which is already known. When there is no indicators at to where you are or where you are going this survey activity is impossible.

By the use of indexes and tables of contents books enable us to preview, survey, find an isolated piece of information, skip ahead or review. If we do not provide similar devices in educational software we have created not more flexible but less flexible educational materials. Some possible devices for allowing more student control over the materials are as follows:

Table of Contents. Like a book a table of contents is a useful tool for an educational program. This should list the major topics to be covered and provide a way for the student to "turn to" a given topic. Look at figure 5, frame B. In the Poetic Meter program after the title page the student is presented with a list of the sections of the program. In his program the student is required to keep track of their own progress (there is no student manager program) and this table of contents was necessary to enable the student to pick up where he or she left off. But even if this was not necessary having the table of contents as an option would facilitate preview and review. In short, **provide a way for the student to skip to the major sections of the program in order to preview, review or repeat portions of the material.**

Location indicators. A table of contents provides a map of where to go and the mechanism for getting there but do you know where you are when you get there. The size of a software program is transparent to the student. It is hard to turn to the last page and see how much more you have to study before it is convenient to take a break. Books use page numbers. On the table of contents page you can observe that a given section is 10 pages long. Then by monitoring the page numbers you can tell how much of the section is left. Some similar concept is needed for educational software. Perhaps a page number is sufficient.

Look at figures 6 through 11. Notice that each display has a number at the bottom of the screen. This is an attempt to tell the student where he or she is in the program. By comparing this number with the table of contents the student can determine where they are in the total program. In short, **provide some sort of location indicator so that the student knows where he or she is in the total program.**

Pages. When studying a book if a student gets distracted it is easy to turn back to the last page and reread the material to pick up on the train of thought. Too often in educational software after the return key has been pressed the last presented material is gone never to be retrieved unless the program is started over. While a table of contents allows preview or review of whole sections of material there is need for a mechanism for short term review or preview. The student must be able to "turn back" to the previous page, to "turn forward" to the next page or, in the case of dynamic displays repeat the current page.

Look at figure 6, frame D and figure 7, frame B. At the conclusion of each page in the Poetic Meter program the student is given the option of going back to the last page by pressing the left arrow key, going on to the next page by pressing the right arrow key or repeating the current page by pressing the return key. In short, **allow the student to**

"turn" the pages by going back to the last page, repeating the current page or going forward to the next page.

Keyboard anxiety.

More people are afraid of keyboards than are afraid of computers. Typing has been seen as a skill for typists (a job description rather than merely a qualification), clerks and secretaries. It is still taught as an elective course in high school (usually in the business department). It is apparent that like handwriting typing will be a basic skill in the future but for the time being we must realize that the majority of the population do not have keyboard skills. This means that lengthy keyboard input is likely to cause anxiety and frustration. Therefore programs should be designed that minimize the amount of information required from the keyboard.

The latest technology in computer programs uses pointing as the primary input device. Pointing, using a mouse or an easily located key, is much easier than finding a particular letter or number on the keyboard. A mouse is a hand held device which rolls on a desk moving a pointer on the screen. A button on the mouse selects the function which the arrow points to on the screen. Pointing is much easier than typing a word or phrase. There are times when we want unstructured input from the student. Figure 6 represents this type of situation. Other times when we are involved in selecting a menu or choosing a response to a question pointing will facilitate the student's interaction. Figure 5 illustrates pointing on a menu. The student merely presses the arrow keys to move the pointer up and down the menu. When the arrow points at the choice that the student wishes to select he or she merely presses the return key. A similar pointing procedure is used in selecting examples and answering practice problems. Figure 8, frame A, shows the use of a pointing device for selecting the type of meter the student wishes to see illustrated. Pressing the space bar moves the pointer (the brackets around the choice in this case) which rotates past each of the choices in turn. The return key gets the choice. Figure 9, frame A shows a similar pointer for practice. In this case the student uses the space bar to select the type of meter illustrated. Pressing the return key accepts the student answer.

Many students get frustrated when required to use the keyboard and this anxiety interferes with learning. In short, **minimize unnecessary typing by using a pointing device whenever possible.**

Advisor.

One aspect of effective teaching is to monitor the student's process and progress and to provide advice for the student to guide further study efforts. This type of monitoring function is difficult to implement in the class room where there are usually many children for every teacher. One advantage of the computer is that it can not only present information to the student but it can gather information from the student. This student generated information can then be used to monitor the student's progress and can serve to trigger advice to the student which may facilitate his or her learning.

The most obvious thing to monitor is the number of practice problems that a student misses. However, there is much other information which can be used to determine if the student is using the instructional program in an effective way. Some of these include monitoring the number of examples studied by the student, checking to see if the student has used the resources provided by the program as well as checking on practice performance.

Look at figure 8, frame B. This display is shown to the student if he or she presses the escape key to terminate the example portion of the program before we as the designer feel that an adequate number of examples have been studied. In fact there is a prior message in this section of the program. If the student tries to escape from the example section before looking at a minimum of two examples of each type a message says, "You must study at least 2 examples of each type." In this example display the amount of prompting material is slowing decreased. Early examples are shown divided into syllables and the word or phrase is chanted for the student. After a few examples the colon which divides the words into syllables is removed and the words are no longer divided into syllables for the student. After a few more examples the chant is turned off and the student merely sees a word or phrase of the type indicated without additional prompts. If the student escapes before seeing at least 2 nonprompted examples of each type the warning message of figure 8, frame B appears. If the student does exceed this criteria then the danger frame is replaced by a frame which say, "GO, you should be ready for practice." Notice that in either the case of the danger or go advice the student has the option to follow the advice or ignore the advice. The black stripe at the bottom of the page gives the student the option of returning for more examples by pressing the left arrow key or going on to practice by pressing the right arrow key. If the student elects to return to the example section of the program the software remembers where the student left off and begins presenting examples from this point.

A similar advisor function follows practice. Look at figure 9, frame C. In this case the student is given a score board showing how many of each type of meter were classified incorrectly. If the student misses more than 2 of any type the warning includes a stop sign and the advice, "You should study more examples." If the student misses less than 1 of each type the display contains a "GO" sign and the advice, "Ok to study the next page". If the performance is between these two criteria levels the display contains a "CAUTION" sign and the advice, "Perhaps you should study more examples." The student is given three options. Turn to the next page by pressing the right arrow. Go back to the example section by pressing the left arrow. Do some more practice by pressing the return key. Again the student has the option to override the advice.

Computers provide the mechanism to monitor not only the student's performance but all of the student's learning activities. The teaching function of advice can easily be implemented. In short, **monitor the student's activity and provide advice when potentially decremental action is taken. In most cases provide a mechanism for the student to override the advice.**

Learner Control.

In the early days of computer assisted instruction advocates often stated that someday we would have a computer system which could assess the readiness and aptitude of the student and then present that information which was an optimal match to the individual student. Even if it were possible there remains some serious ramifications of this assumption. If a significant part of the curriculum was constructed around such adaptive instruction the gains on the part of the student in the subject matter being taught might be considerable but the side effects could be catastrophic. The students in such a system would be spoon fed and might never learn to feed themselves. The real world is seldom so accommodating. If one of the primary aims of education is to assist the student to be an independent learner and acquire additional learning by self teaching then our highly adaptive CAI system may turn out to be maladaptive after all. Students who have a major part of their learning on such an accommodating system would not learn the important metaskills necessary to learn from less than optimal information.

A better approach might be to teach the student to adapt the system to themselves rather than for the system to adapt itself to the student. The mechanism for this student adaptation is to provide learner control so that many decisions about the next best display is left to the student. Rather than big brother providing the information for the student the student must select that information that he or she thinks is best for himself or herself.

Text output. In an earlier section we discussed student control of text output. This is an obvious area where students can determine for themselves when they are ready for the next display. Exceptions might be in timed tests or when speed reading is the objective but usually the student should indicate, "I'm ready to continue."

Number of examples. Research has shown that most students can determine how many examples they need to study in order to understand an idea. The number of examples required by different individuals may differ considerably but if an individual is shown less than he or she feels is needed there will be a decrement in performance. On the other hand, showing them more than they think is needed serves only to prolong the instruction without any accompanying increase in performance.

Look at figure 8, frame A. In this presentation the student can determine the number of examples needed to understand each type of meter. When the student feels that enough have been studies he or she presses the escape key and jumps to the practice section. Note that the advisor function previously discussed comes into play to monitor the student's use of learner control. If in our opinion the student might be using learner control to avoid what might be necessary study the program provides a caution to the student. However, the student is still in control and can usually override the advice. In short, **allow students to select how many examples they need to study.**

Optional help. Students differ significantly in the amount of elaboration they need to understand an idea. Some students need a step by step explanation while others understand after the general idea has been presented or after they have seen an example. It is inefficient and may cause frustration for the student if forced to work through every step of a detailed analysis. On the other hand if this detailed analysis is not available some students will be lost.

Look at figure 10. This sequence of frames illustrates the detailed analysis of the poetry scanning procedure. First, the student is advised to read the poem aloud and take a guess a the type of meter involved (frame A). The scanning editor then "chants" the poem for the student using the sound to indicate the stress pattern involved. In frame B the student is advised to separate multisyllable words into separate syllables using the colon. In frame C the student is advised to mark the stressed syllables using the underline. And in frame D the student is advised to divide the passage into poetic feet using the up arrow. Finally the student is asked to observe the pattern of stress in each foot and indicate the type of meter involved.

Some students need to repeat this detailed analysis many times while others will get the idea very quickly. Students can jump to the practice at any time by pressing the escape key. In the practice section (see figure 11) the student is asked to classify the type of meter involved in the passage (frame A). In frame B the word RIGHT or WRONG is flashed in the upper right part of the screen to indicate whether or not the classification was correct. The passage is then chanted for the student to allow comparison. The correct choice is not indicated to the student when he or she is wrong. The student can then choose whether or not to engage in the more detailed analysis. Pressing the [?] key causes frame D to appear and then follows a detailed scanning analysis such as was presented in the example section.

Because students differ in the amount of detailed elaboration they need they should be given a choice as to whether or not they wish more explanation. Forcing all students through a linear path consisting of the same level of detail may be boring for some students because the pace is too slow and frustrating for others because the pace is too fast. In short,**provide optional help, don't force every student through the most detailed presentation.**

Escape. Sometimes students are interrupted while studying. There are many causes for such interruptions. If a student is in a long sequence they are very hesitant to merely pull out the disk and turn off the computer. This may mean that they must start over the next time or they may fear that this will somehow ruin the program. The program should provide a way for the student to return to the menu or some other starting place.

Poetic Meter allows the student to escape from any sequence by pressing the escape key. Usually the consequence of such an action is indicated by the program. In the example sections the program uses the escape as a means of learner control for the student to tell the program that they have seen enough examples and wish to go on. The advisor warns the student if we feel that the student should study more examples. This program does not have a student manager so if the student uses escape to leave the program the program starts over when the program is restarted. Including a student manager is better. This provides a way for the program to restart the student where they left off without the student having to keep track and use the menu to find their place.

Everyone suffers from interruptions and needs a way to exit in an orderly way short of pulling the plug. In short, **provide a means of escape from any lengthy activity but advise the student about the consequence of such an escape.**

Directions.

Those of us who have been in the computer business for some years have come to accept a number of conventions that seem like second nature. For example, everyone that has used a computer very long soon learns that to enter a response it is usually necessary to press the return or enter key. This is so obvious to us that we usually feel that to inform the student about this convention is unnecessary. However, more and more first time users are beginning to use the computer. What may be obvious to an experienced user is not at all obvious to the first time user. The learner will have a more pleasant experience if the program contains complete directions about what to do and when.

Often documentation will contain the necessary directions but if they are at all complex, as in editors where there are several options available, most users find that it is necessary to have a summary card in order to remember which commands go with the program. If possible the current options should be available to the student as options on the screen.

Look at figure 9, frame A. This is a simple exercise but the directions for the student are shown on the screen so that what is necessary to make the selection is clearly indicated. The Poetic Meter program makes a poor assumption on figure 6, frames A and B. It assumes that the student will know that when the cursor appears he or she should enter an answer and then press the return key. It would be an improvement if this direction appeared on the screen at least for the first few times the student is expected to make some constructed response to a request from the program.

Don't create interfering directions. Sometimes in an attempt to make it very clear to the beginning user the procedures become very inconvenient for the experienced user. This is probably less of a problem in an educational program than it is in some utility such as a word processor or data base. Nevertheless we should be careful to balance directions so that the program is easy to use for the beginner but convenient to use for the more experienced user.

Make the directions as natural as possible. There is nothing more difficult than a long menu that is numbered. The user must look at the menu, get an arbitrary number, and hunt for the number on the keyboard in order to make a selection. Mnemonic choices using the first letter of the word may be easier to remember. Pointing, as already mentioned, is easiest of all. Keys should be used in a natural way or in ways consistent with other systems. Unique combinations of key presses make it unnecessarily difficult for the student. Even the advise to the student should use already known symbols. In the Poetic Meter program the advisor uses "STOP", "CAUTION" and "GO" as ways to get the student's attention quickly and to leave little ambiguity about what is being said. (See figure 8, frame B and figure 9, frame C.) In short, **provide adequate directions including all of the options available to the student. If possible make these available on the screen or accessible with the press of the [?] key. Use the most natural procedure.**

Program Structure.

This paper has not dealt with programming design but it is necessary to border on the architecture of the program for one final human factors concern. While the power and capacity of personal computers seems to increase daily with each new product on the market, there are still severe limitations of space and size. These limitations can interfere with effective educational design. Some popular programs are very annoying because they continually access the disk drive. For the student it seems like half the time is spent waiting for the computer to load the next part of the program. The polite message, "Thank you for waiting." gets very old in a hurry. By carefully structuring the program these long delays in processing or accessing information can be minimized. It is especially important that there be no delays between the time when a student enters information and the computer reacts to that information. If there is a delay the student often feels that the computer is not operating properly and may try to enter additional information. Whenever possible the next part of the program should be anticipated and loaded during a time when the student is busy with other activities on the screen. Thus when the student indicates that he or she is ready to continue the next part of the program is already in memory and easily displayed to the student. In short, **plan disk access to avoid long waits while the computer retrieves information.**

In Conclusion.

Education Secretary Terrel Bell has recently criticized educational software as "electronic page turning [that] hasn't been designed to do a good job of interacting with the mind of the student." He further states that computers could be used as "slave mechanisms" to check spelling, punctuation and sentence structure but he doubts that computers could ever teach writing. As a designer of educational software (including software that teaches writing and poetic meter) I was ready to go to battle with the good Secretary. Then I realized that a random sampling of educational software might very well create the impression that computers are pretty limited in what they can teach. It is time that the consumers of educational programs become more discerning and refuse to purchase software that does not meet at least the minimum standards of acceptable instruction. This paper has attempted to provide a few suggestions about some of those minimum standards.

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SUMMARY

Instructional Strategies

The first section of this paper identifies design strategies which are believed to have a direct impact on the amount of learning that occurs as a result of instruction. Instructional design strategy involves the arrangement of content elements and other information in such a way that learning is facilitated. The following guidelines are suggested:

1. Avoid merely putting text on the screen; avoid mere page turning.

2. Avoid generality-rich but example-poor presentations. Each idea should be presented by a generality, examples and practice.

3. Avoid remember only practice.

4. Use attention focusing devices to relate examples to generalities and to point out critical characteristics of the illustrative material.

5. Promote active mental processing by asking rhetorical questions and engaging the student in a conversation which requires constructed (as opposed to multiple choice) responses to which we do not provide right-wrong feedback but rather an anticipation of a reasonable reaction.

6. Provide expository examples as well as practice.

Display Techniques

The second section of this paper identifies screen display techniques which are believed to facilitate the students ability to interact with the materials. Screen display refers to the way that information is exhibited on the monitor. The following guidelines are suggested:

1. No scrolling for educational programs.

2. The student should control text output. Never erase critical information until the student indicates readiness to proceed OR provide a way for the student to repeat dynamically presented information.

3. Use dynamic displays in which timing of text output, inverse text, flashing and animation are used for stress and emphasis.

4. Dark letters on a light screen will appear less confined and more natural to the student.

5. Leave plenty of white space and erase information when it is no longer needed.

6. Use short lines and separate natural phrases or ideas on each line.

7. Don't fill justify text on the screen.

8. Do not present information in all upper case except for emphasis.

9. Use a variety of text styles to indicate different kinds of messages.

Human Factors

The third section of this paper identifies some human factors characteristics which will make educational software easier to use and thus result in more efficient learning. The following guidelines are suggested:

1. Provide a way for the student to skip to the major sections of the program in order to preview, review or repeat portions of the material.

2. Provide some sort of location indicator so that the student knows where he or she is in the total program.

3. Allow the student to "turn" the pages by going back to the last page, repeating the current page or going forward to the next page.

4. Minimize unnecessary typing by using a pointing device whenever possible.

5. Monitor the student's activity and provide advice when potentially decremental action is taken. In most cases provide a mechanism for the student to override the advice.

6. Allow students to select how many examples they need to study.

7. Provide optional help, don't force every student through the most detailed presentation.

8. Provide a means of escape from any lengthy activity but advise the student about the consequence of such an escape.

9. Provide adequate directions including all of the options available to the student. If possible list the available options on the screen or make them accessible with the press of the [?] key. Use the most natural procedure.

10. Plan disk access to avoid long waits while the computer retrieves information.

FIGURES

Figure 1 Drill and practice program.

Figure 2 NOT-SO-GOOD Poetic Meter.

Figure 3 NOT-SO-GOOD Poetic Meter continued.

Figure 4 EDU-WARE FRACTIONS with animation.

Figure 5 Table of Contents - Poetic Meter.

Figure 6 Presentation page 1 - Poetic Meter.

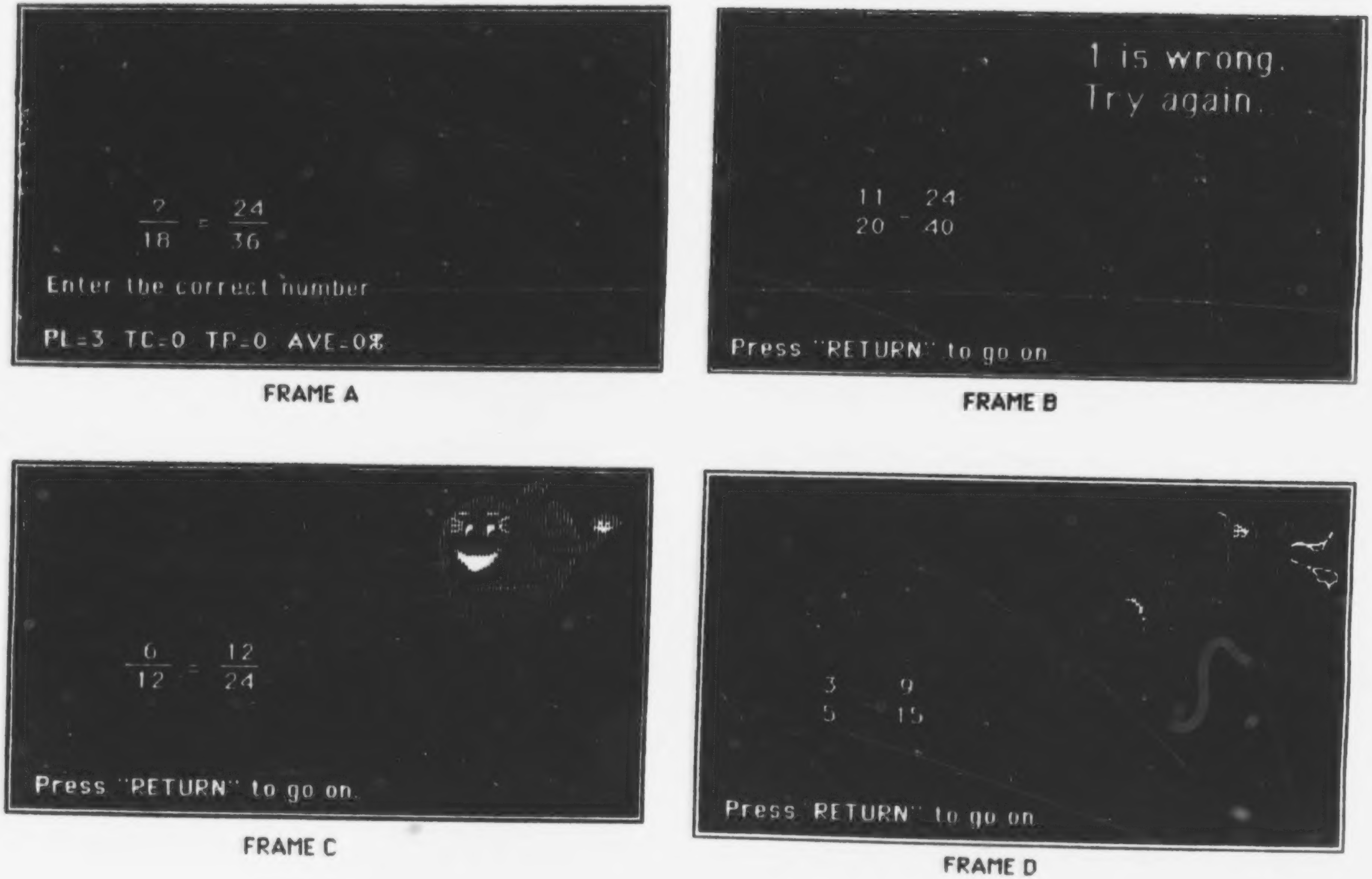
Figure 7 Presentation selected pages - Poetic Meter.

Figure 8 Word Example - Poetic Meter.

Figure 9 Word Practice - Poetic Meter.

Figure 10 Verse Example with scanning editor - Poetic Meter.

Figure 11 Verse Practice with scanning editor - Poetic Meter.



$\frac{?}{18} = \frac{24}{36}$

Enter the correct number

PL=3 TC=0 TP=0 AVE=0%

FRAME A

1 is wrong.
Try again.

$\frac{11}{20} = \frac{24}{40}$

Press "RETURN" to go on

FRAME B

$\frac{6}{12} = \frac{12}{24}$

Press "RETURN" to go on.

FRAME C

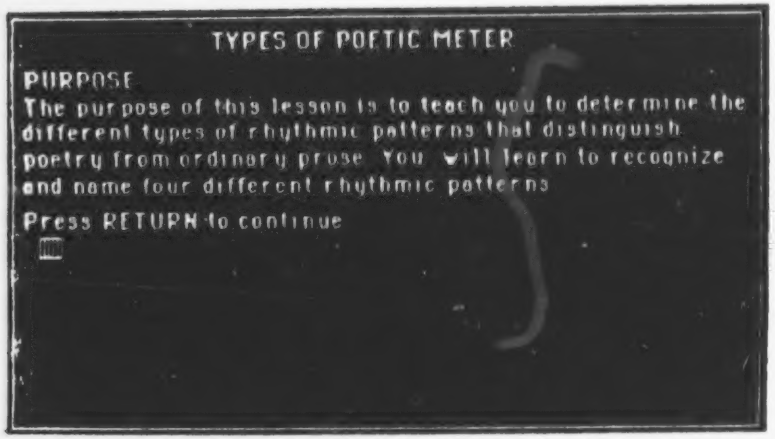
$\frac{3}{5} = \frac{9}{15}$

Press "RETURN" to go on.

FRAME D

Figure 1 Drill and practice program.

BEST COPY AVAILABLE



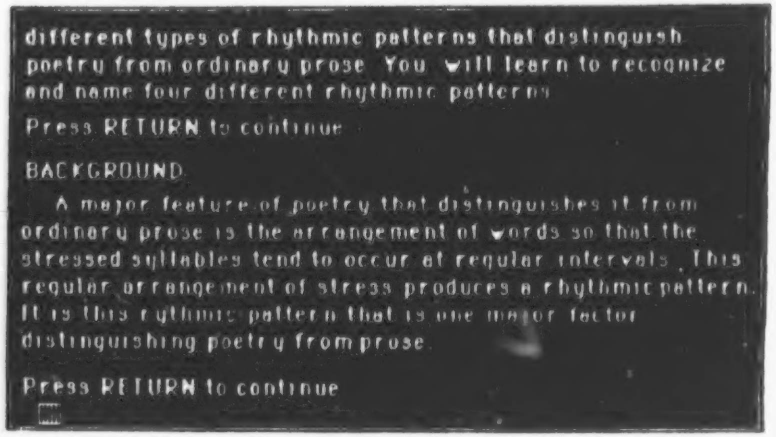
TYPES OF POETIC METER

PURPOSE

The purpose of this lesson is to teach you to determine the different types of rhythmic patterns that distinguish poetry from ordinary prose. You will learn to recognize and name four different rhythmic patterns.

Press RETURN to continue

FRAME A



different types of rhythmic patterns that distinguish poetry from ordinary prose. You will learn to recognize and name four different rhythmic patterns.

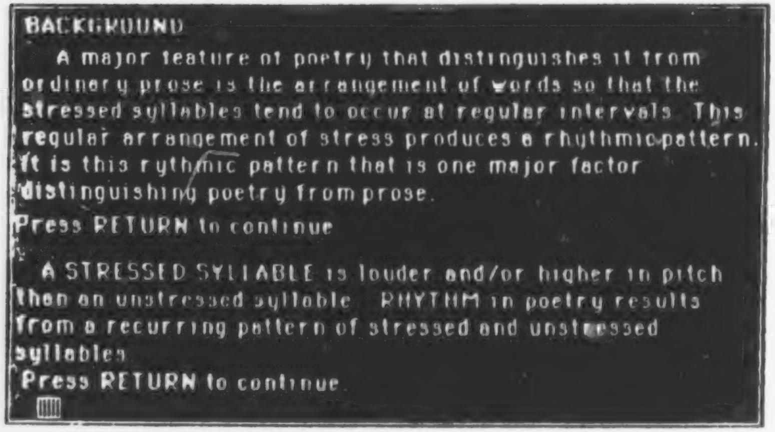
Press RETURN to continue

BACKGROUND

A major feature of poetry that distinguishes it from ordinary prose is the arrangement of words so that the stressed syllables tend to occur at regular intervals. This regular arrangement of stress produces a rhythmic pattern. It is this rythmic pattern that is one major factor distinguishing poetry from prose.

Press RETURN to continue

FRAME B



BACKGROUND

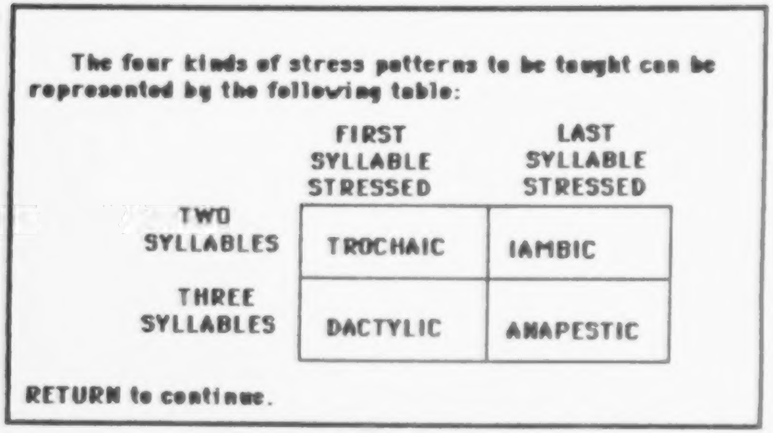
A major feature of poetry that distinguishes it from ordinary prose is the arrangement of words so that the stressed syllables tend to occur at regular intervals. This regular arrangement of stress produces a rhythmic pattern. It is this rythmic pattern that is one major factor distinguishing poetry from prose.

Press RETURN to continue

A STRESSED SYLLABLE is louder and/or higher in pitch than an unstressed syllable. RHYTHM in poetry results from a recurring pattern of stressed and unstressed syllables.

Press RETURN to continue.

FRAME C



The four kinds of stress patterns to be taught can be represented by the following table:

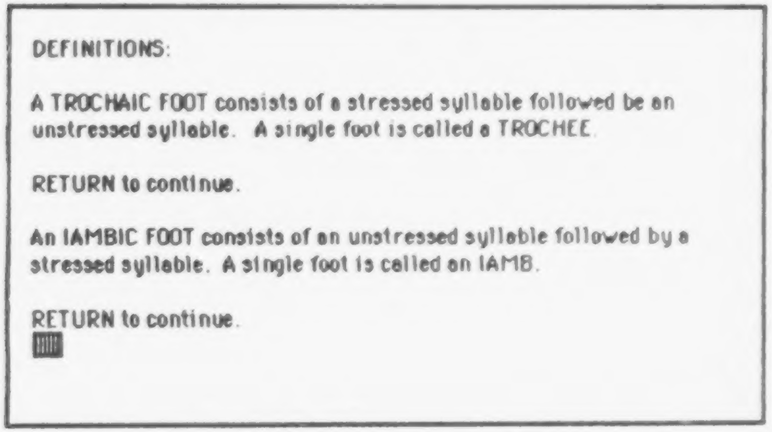
	FIRST SYLLABLE STRESSED	LAST SYLLABLE STRESSED
TWO SYLLABLES	TROCHAIC	IAMBIC
THREE SYLLABLES	DACTYLIC	ANAPESTIC

RETURN to continue.

FRAME D

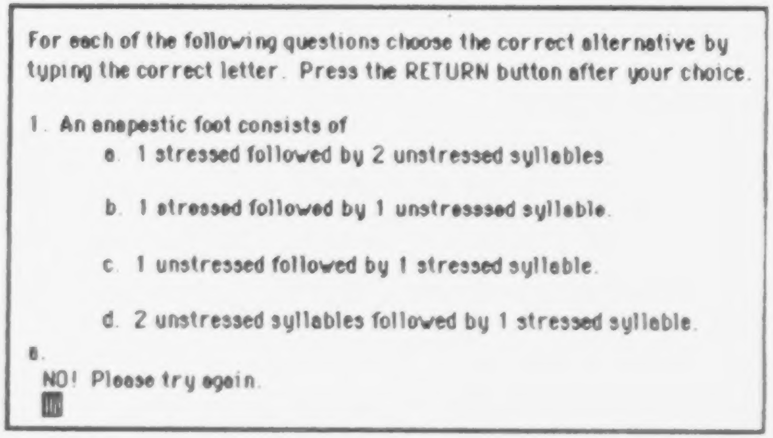
Figure 2   NOT-SO-GOOD Poetic Meter

BEST COPY AVAILABLE



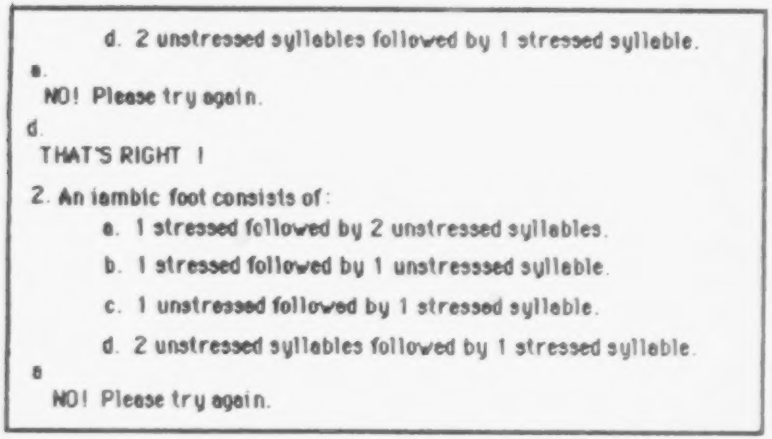
```
DEFINITIONS:

A TROCHAIC FOOT consists of a stressed syllable followed be an
unstressed syllable.  A single foot is called a TROCHEE.

RETURN to continue.

An IAMBIC FOOT consists of an unstressed syllable followed by a
stressed syllable.  A single foot is called an IAMB.

RETURN to continue.
```

FRAME A



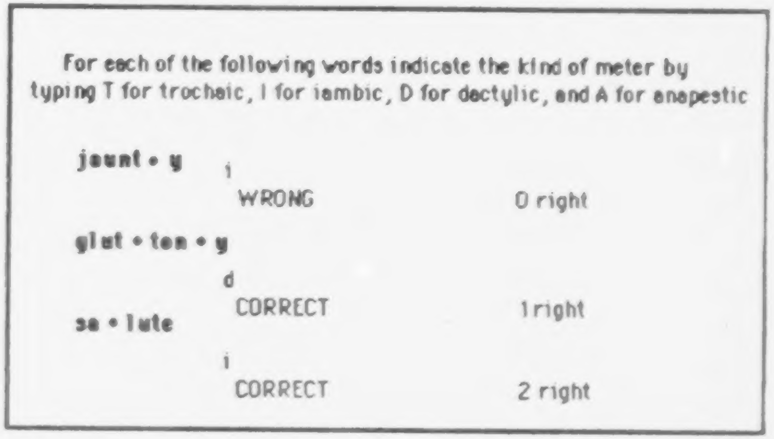
```
For each of the following questions choose the correct alternative by
typing the correct letter.  Press the RETURN button after your choice.

1.  An anapestic foot consists of
        a.  1 stressed followed by 2 unstressed syllables.

        b.  1 stressed followed by 1 unstressed syllable.

        c.  1 unstressed followed by 1 stressed syllable.

        d.  2 unstressed syllables followed by 1 stressed syllable.
a.
 NO!  Please try again.
```

FRAME B



```
        d.  2 unstressed syllables followed by 1 stressed syllable.
a.
 NO!  Please try again.
d.
 THAT'S RIGHT  !
2. An iambic foot consists of:
        a.  1 stressed followed by 2 unstressed syllables.
        b.  1 stressed followed by 1 unstressed syllable.
        c.  1 unstressed followed by 1 stressed syllable.
        d.  2 unstressed syllables followed by 1 stressed syllable.
a
 NO!  Please try again.
```

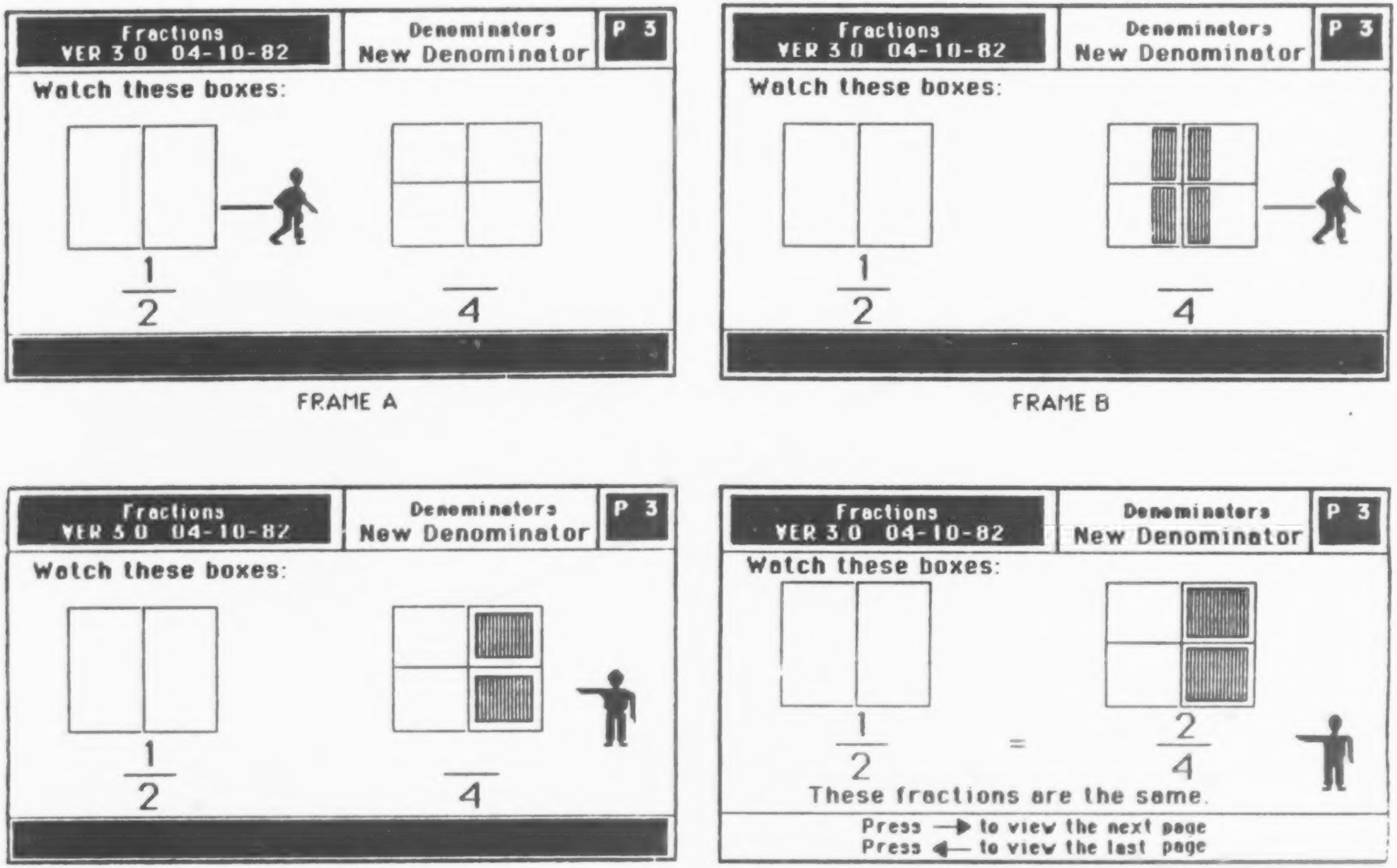
FRAME C



```
  For each of the following words indicate the kind of meter by
typing T for trochaic, I for iambic, D for dactylic, and A for anapestic

   jaunt • y      i
                   WRONG                 0 right
   glut • ton • y
                  d
                   CORRECT               1 right
   sa • lute
                  i
                   CORRECT               2 right
```

FRAME D

Figure 3   NOT-SO-GOOD Poetic Meter continued



Fractions
VER 3.0 04-10-82

Denominators
New Denominator

P 3

Watch these boxes:

$\frac{1}{2}$ $\frac{\ }{4}$

FRAME A

Fractions
VER 3.0 04-10-82

Denominators
New Denominator

P 3

Watch these boxes:

$\frac{1}{2}$ $\frac{\ }{4}$

FRAME B

Fractions
VER 3.0 04-10-82

Denominators
New Denominator

P 3

Watch these boxes:

$\frac{1}{2}$ $\frac{\ }{4}$

FRAME C

Fractions
VER 3.0 04-10-82

Denominators
New Denominator

P 3

Watch these boxes:

$\frac{1}{2} = \frac{2}{4}$

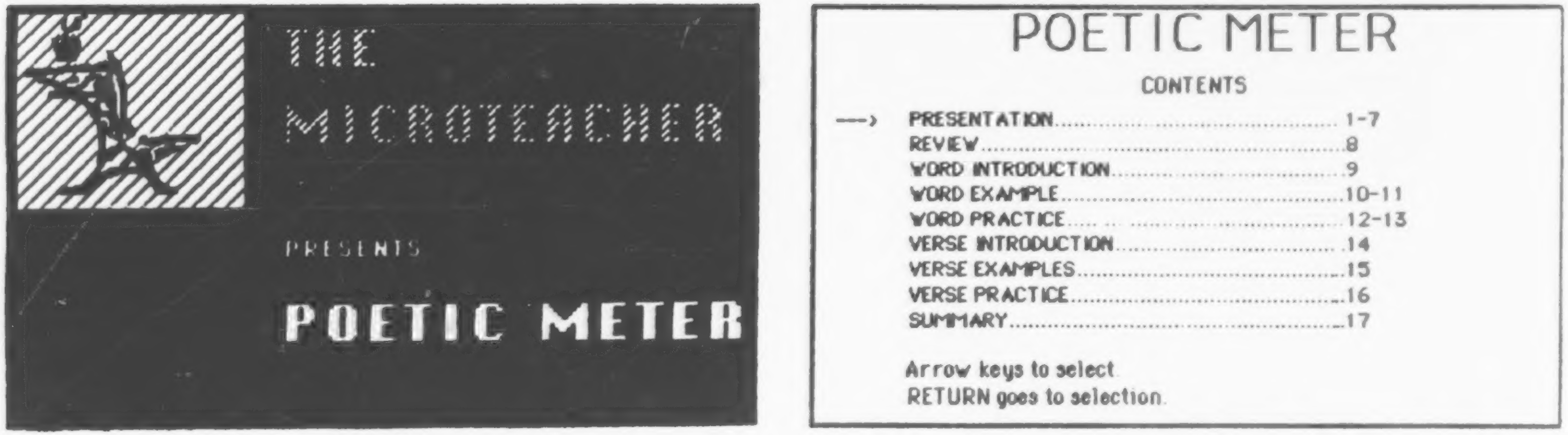
These fractions are the same.

Press → to view the next page
Press ← to view the last page

FRAME D

Figure 4 EDU-WARE FRACTIONS with animation

BEST COPY AVAILABLE



THE
MICROTEACHER
PRESENTS
POETIC METER

FRAME A

POETIC METER

CONTENTS

---> PRESENTATION..1-7
REVIEW..8
WORD INTRODUCTION.......................................9
WORD EXAMPLE..10-11
WORD PRACTICE...12-13
VERSE INTRODUCTION......................................14
VERSE EXAMPLES..15
VERSE PRACTICE...16
SUMMARY..17

Arrow keys to select.
RETURN goes to selection.

FRAME B

Figure 5 Table of Contents - Poetic Meter

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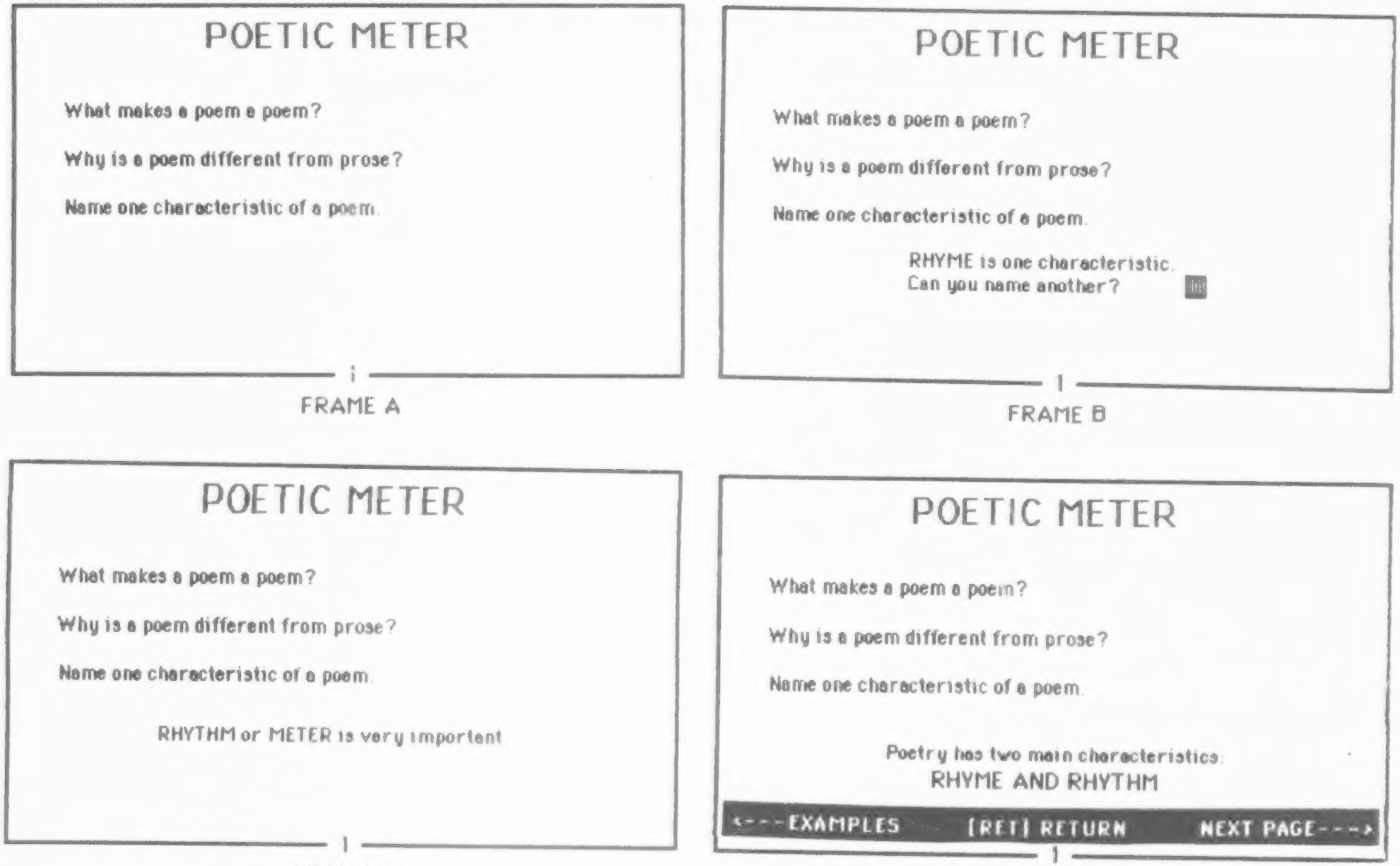


POETIC METER

What makes a poem a poem?

Why is a poem different from prose?

Name one characteristic of a poem.

1

FRAME A

POETIC METER

What makes a poem a poem?

Why is a poem different from prose?

Name one characteristic of a poem.

RHYME is one characteristic.
Can you name another?

1

FRAME B

POETIC METER

What makes a poem a poem?

Why is a poem different from prose?

Name one characteristic of a poem.

RHYTHM or METER is very important

1

FRAME C

POETIC METER

What makes a poem a poem?

Why is a poem different from prose?

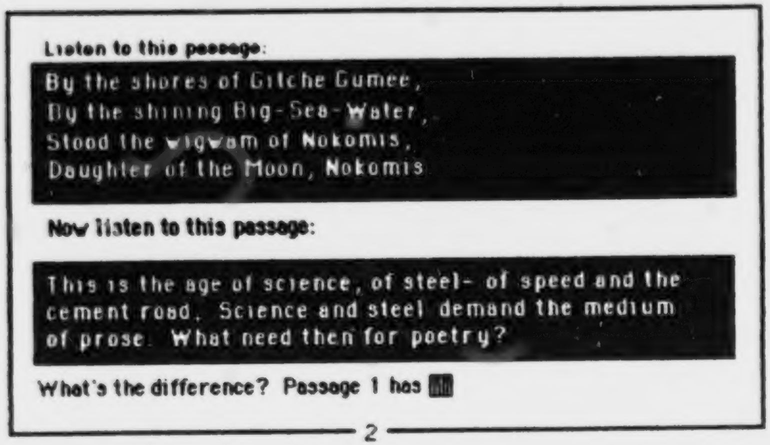
Name one characteristic of a poem.

Poetry has two main characteristics:
RHYME AND RHYTHM

1

FRAME D

Figure 6 Presentation page 1 - Poetic Meter



Listen to this passage:

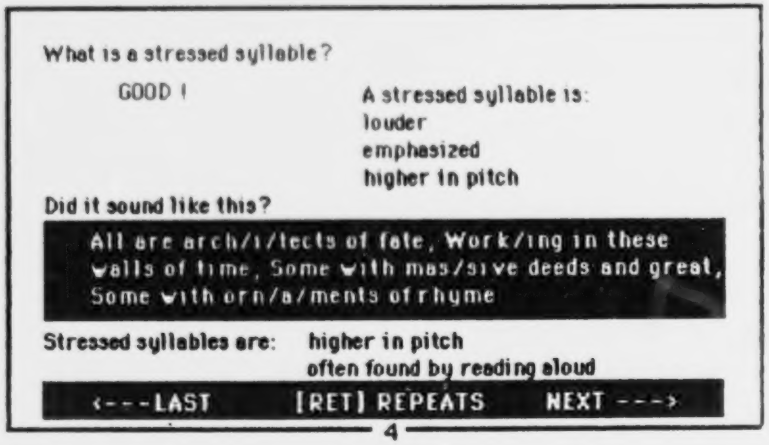
By the shores of Gitche Gumee,
By the shining Big-Sea-Water,
Stood the wigwam of Nokomis,
Daughter of the Moon, Nokomis

Now listen to this passage:

This is the age of science, of steel- of speed and the cement road. Science and steel demand the medium of prose. What need then for poetry?

What's the difference? Passage 1 has ▮

FRAME A



What is a stressed syllable?

GOOD !

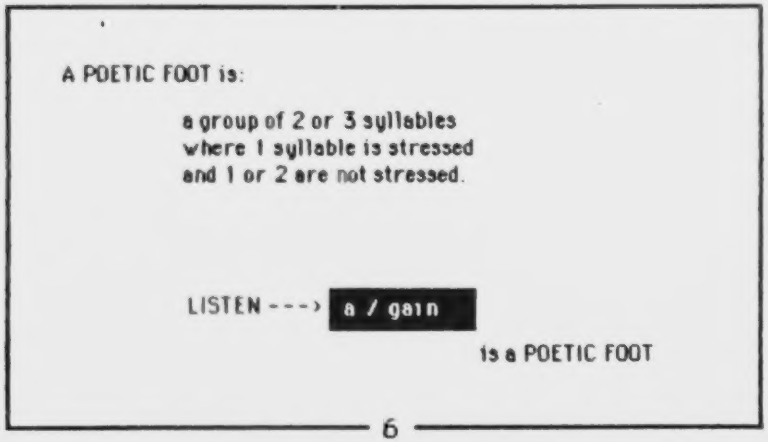
A stressed syllable is:
louder
emphasized
higher in pitch

Did it sound like this?

All are arch/i/tects of fate, Work/ing in these walls of time, Some with mas/sive deeds and great, Some with orn/a/ments of rhyme

Stressed syllables are: higher in pitch
often found by reading aloud

FRAME B



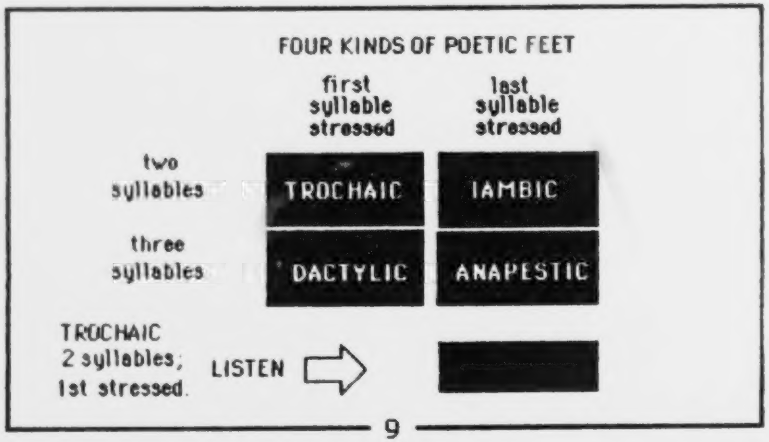
A POETIC FOOT is:

a group of 2 or 3 syllables
where 1 syllable is stressed
and 1 or 2 are not stressed.

LISTEN ---> a / gain

is a POETIC FOOT

FRAME C



FOUR KINDS OF POETIC FEET

	first syllable stressed	last syllable stressed
two syllables	TROCHAIC	IAMBIC
three syllables	DACTYLIC	ANAPESTIC

TROCHAIC
2 syllables;
1st stressed.

FRAME D

Figure 7 Presentation selected pages - Poetic Meter

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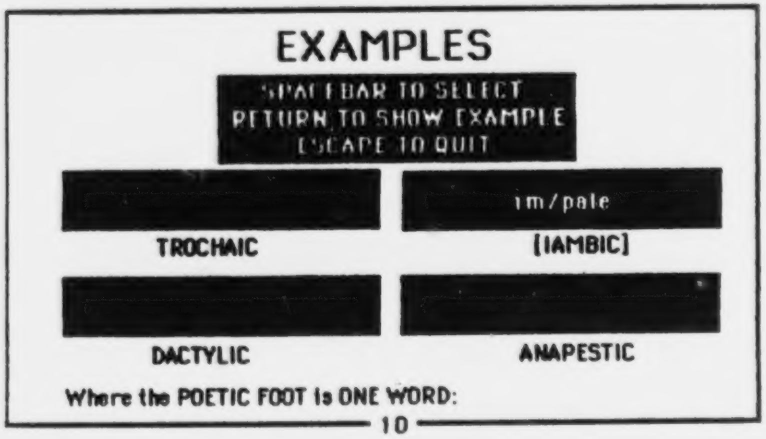


EXAMPLES

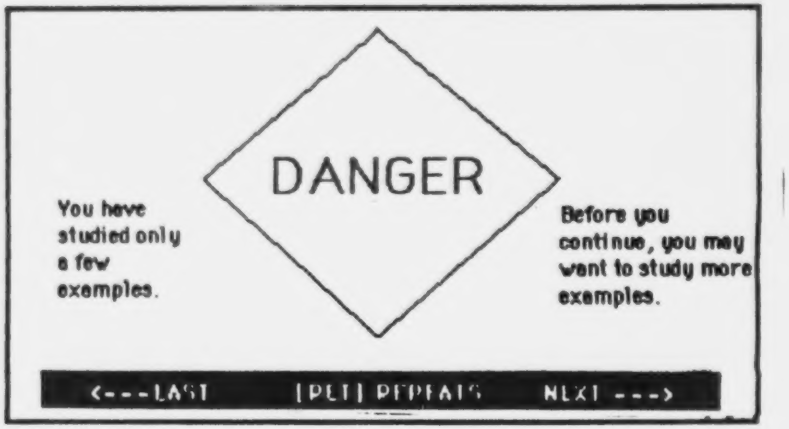
SPACEBAR TO SELECT
RETURN TO SHOW EXAMPLE
ESCAPE TO QUIT

im/pale
TROCHAIC
[IAMBIC]
DACTYLIC
ANAPESTIC

Where the POETIC FOOT is ONE WORD:

10

FRAME A



DANGER

You have studied only a few examples.

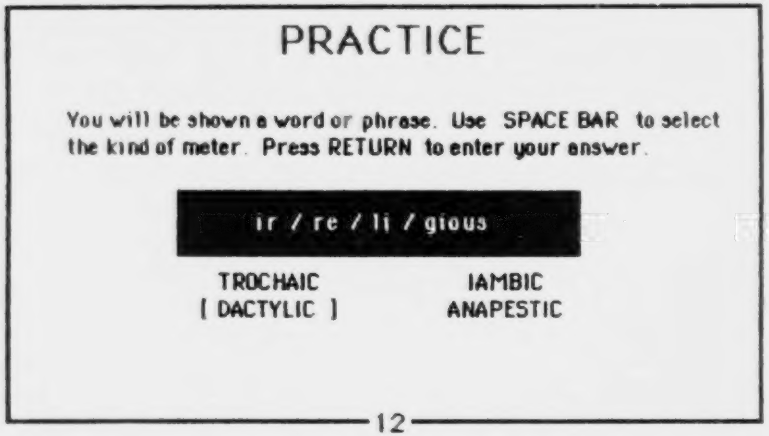
Before you continue, you may want to study more examples.

<---LAST
[RET] REPEATS
NEXT --->

FRAME B

Figure 8 Word Example - Poetic Meter

BEST COPY AVAILA



PRACTICE

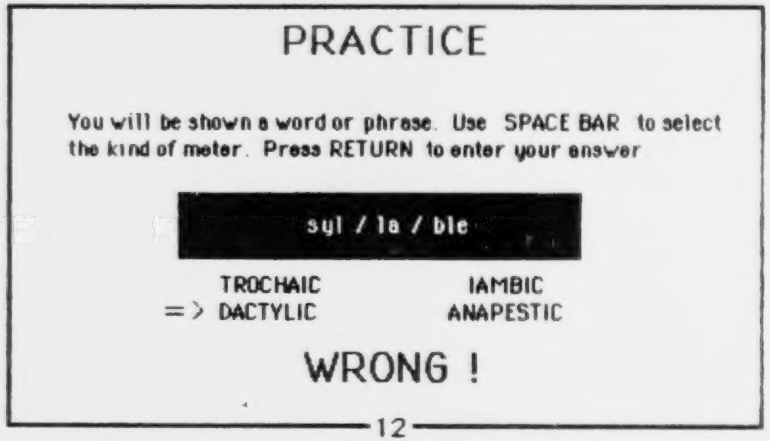
You will be shown a word or phrase. Use SPACE BAR to select the kind of meter. Press RETURN to enter your answer.

ir / re / li / gious

TROCHAIC IAMBIC
[DACTYLIC] ANAPESTIC

12

FRAME A



PRACTICE

You will be shown a word or phrase. Use SPACE BAR to select the kind of meter. Press RETURN to enter your answer.

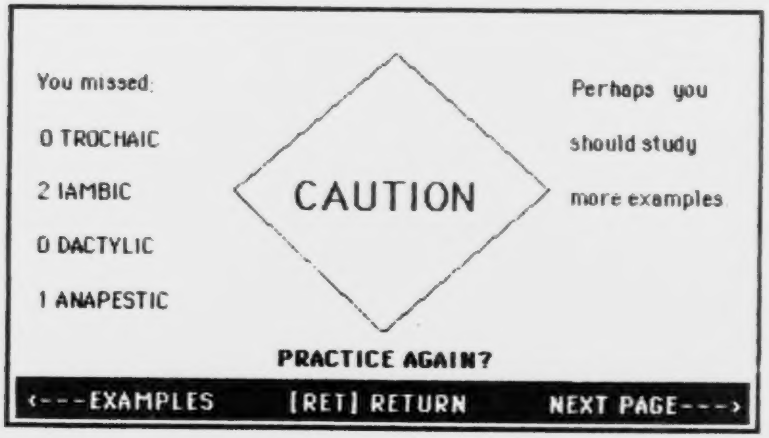
syl / la / ble

TROCHAIC IAMBIC
=> DACTYLIC ANAPESTIC

WRONG !

12

FRAME B



You missed:

0 TROCHAIC

2 IAMBIC

0 DACTYLIC

1 ANAPESTIC

CAUTION

Perhaps you should study more examples.

PRACTICE AGAIN?

FRAME C

Figure 9 Word Practice - Poetic Meter

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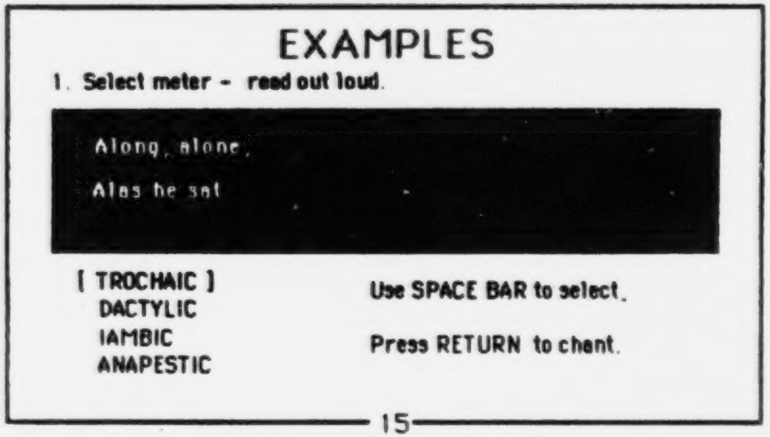


EXAMPLES

1. Select meter - read out loud.

Along, alone,
Alas he sat

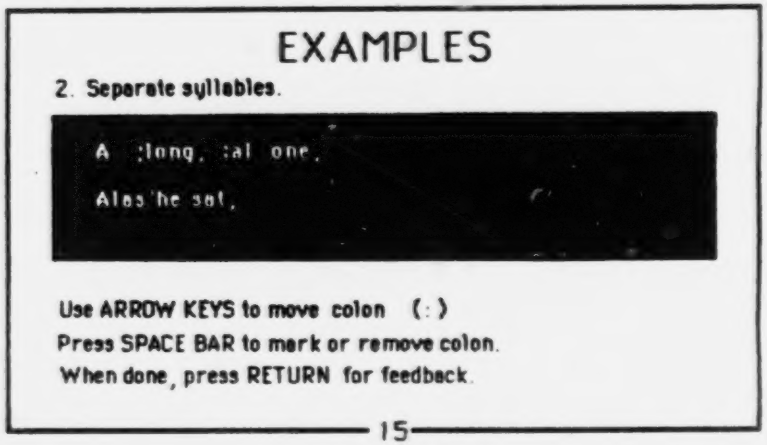
[TROCHAIC]
DACTYLIC
IAMBIC
ANAPESTIC

Use SPACE BAR to select.

Press RETURN to chant.

15

FRAME A



EXAMPLES

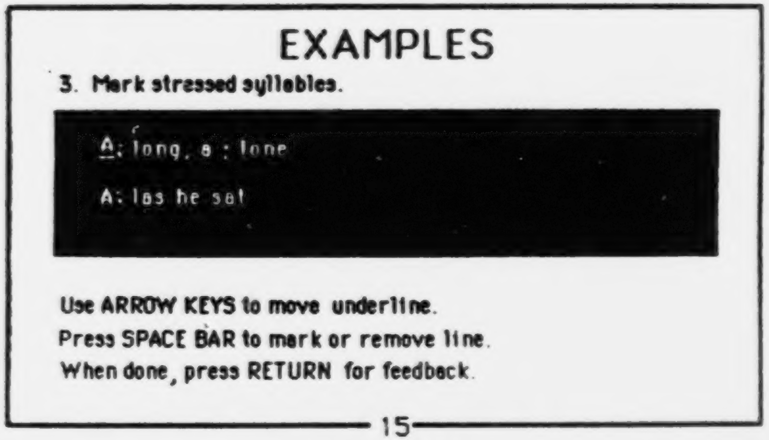
2. Separate syllables.

A :long, :al one,
Alas he sat,

Use ARROW KEYS to move colon (:)
Press SPACE BAR to mark or remove colon.
When done, press RETURN for feedback.

15

FRAME B



EXAMPLES

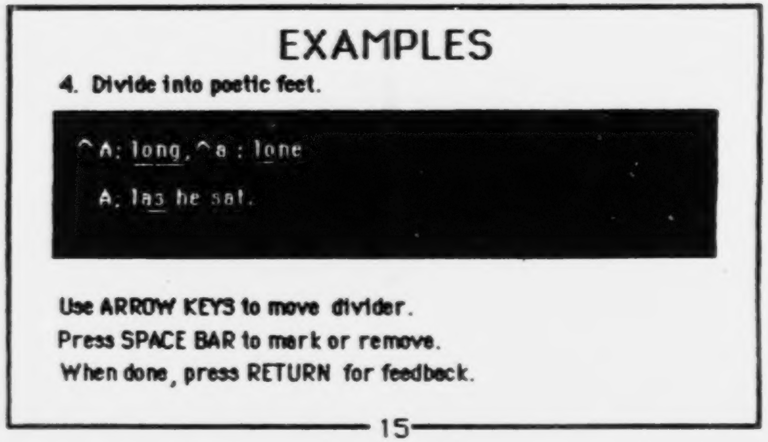
3. Mark stressed syllables.

A: long, a : lone
A: las he sat

Use ARROW KEYS to move underline.
Press SPACE BAR to mark or remove line.
When done, press RETURN for feedback.

15

FRAME C



EXAMPLES

4. Divide into poetic feet.

^A: long,^a : lone
A: las he sat.

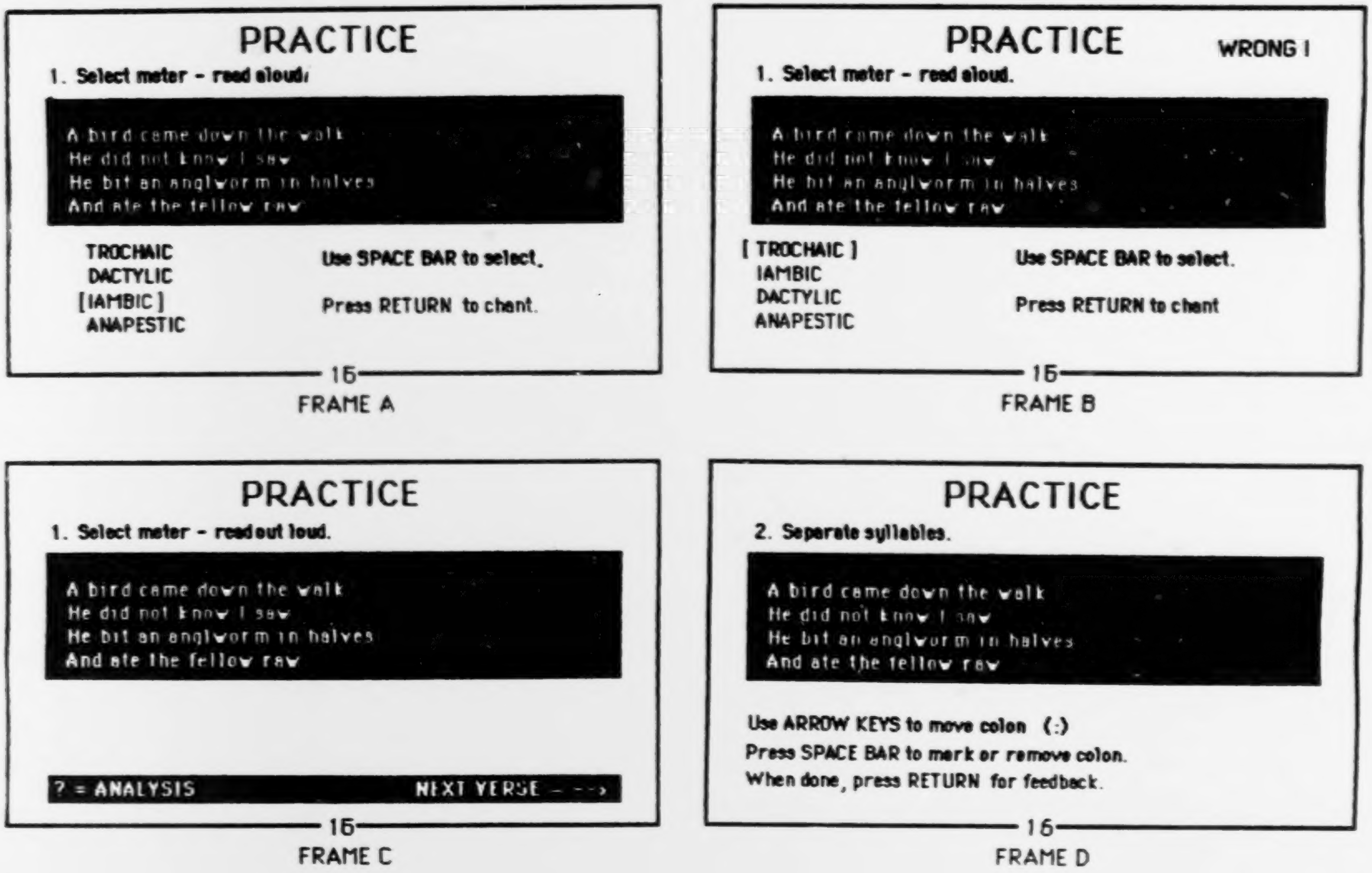
Use ARROW KEYS to move divider.
Press SPACE BAR to mark or remove.
When done, press RETURN for feedback.

15

FRAME D

Figure 10 Verse Example with scanning editor - Poetic Meter

BEST COPY AVAILABLE



PRACTICE

1. Select meter - read aloud.

A bird came down the walk
He did not know I saw
He bit an anglworm in halves
And ate the fellow raw

TROCHAIC
DACTYLIC
[IAMBIC]
ANAPESTIC

Use SPACE BAR to select.

Press RETURN to chant.

16

FRAME A

PRACTICE WRONG !

1. Select meter - read aloud.

A bird came down the walk
He did not know I saw
He bit an anglworm in halves
And ate the fellow raw

[TROCHAIC]
IAMBIC
DACTYLIC
ANAPESTIC

Use SPACE BAR to select.

Press RETURN to chant

16

FRAME B

PRACTICE

1. Select meter - read out loud.

A bird came down the walk
He did not know I saw
He bit an anglworm in halves
And ate the fellow raw

? = ANALYSIS NEXT VERSE --->

16

FRAME C

PRACTICE

2. Separate syllables.

A bird came down the walk
He did not know I saw
He bit an anglworm in halves
And ate the fellow raw

Use ARROW KEYS to move colon (:)

Press SPACE BAR to mark or remove colon.

When done, press RETURN for feedback.

16

FRAME D

Figure 11 Verse Practice with scanning editor - Poetic Meter

BIOGRAPHY - M. DAVID MERRILL

Dr. M. David Merrill, Professor of Educational Psychology at the University of Southern California,and President of Microteacher, Inc., is an internationally recognized scholar in the area of computer-based instruction.

Dr. Merrill received his B.A. in 1961 from Brigham Young University and M.A. (1964) and Ph.D. (1964) from the University of Illinois in Educational and Experimental Psychology. Dr. Merrill has been Vice President/Research Scientist of Courseware, Inc. While at Brigham Young University, he served as Associate Director of the Division of Instructional Research, Development and Evaluation and Chairman of the Educational Psychology Program. In 1969, Dr. Merrill established the new department of Instructional Research and Development in the Instructional Services Division. This department and the associated Instructional Psychology Ph.D. Program which he established in 1970, attained national attention during the next decade. The department was the parent organization of the Institute for Computer Uses in Education (ICUE), and the Department of Instructional Evaluation and Testing (DIET).

Since 1963, Dr. Merrill has authored or coauthored 48 technical papers, 35 journal articles, 9 books, 10 chapters in books, 15 instructional development products, several columns and a number of reviews. He has also participated in numerous workshops and seminars.

COMPUTERIZED EXAM ADMINISTERING SYSTEM AND STUDENT GRADEBOOK

by

Bob Creel

and

Greg Baker

New Mexico State University

Introduction

The proliferation of computers in homes, businesses, and educational institutions has created many opportunities which several years ago would have been impossible. In the educational arena, computer use is not only the goal of instruction but oftentimes the means by which instruction is accomplished and enhanced. Creative use of the computer can save teachers time, make classroom presentations more interesting and effective, and increase the amount of information presented and retained. In this paper, we will present two ways in which computers have been used effectively in the educational process.

Computerized Exam Administering System

One of the time-consuming processes an instructor faces is that of constructing, administering, and grading of examinations. The first section of this paper describes a computer system developed to administer and grade examinations.

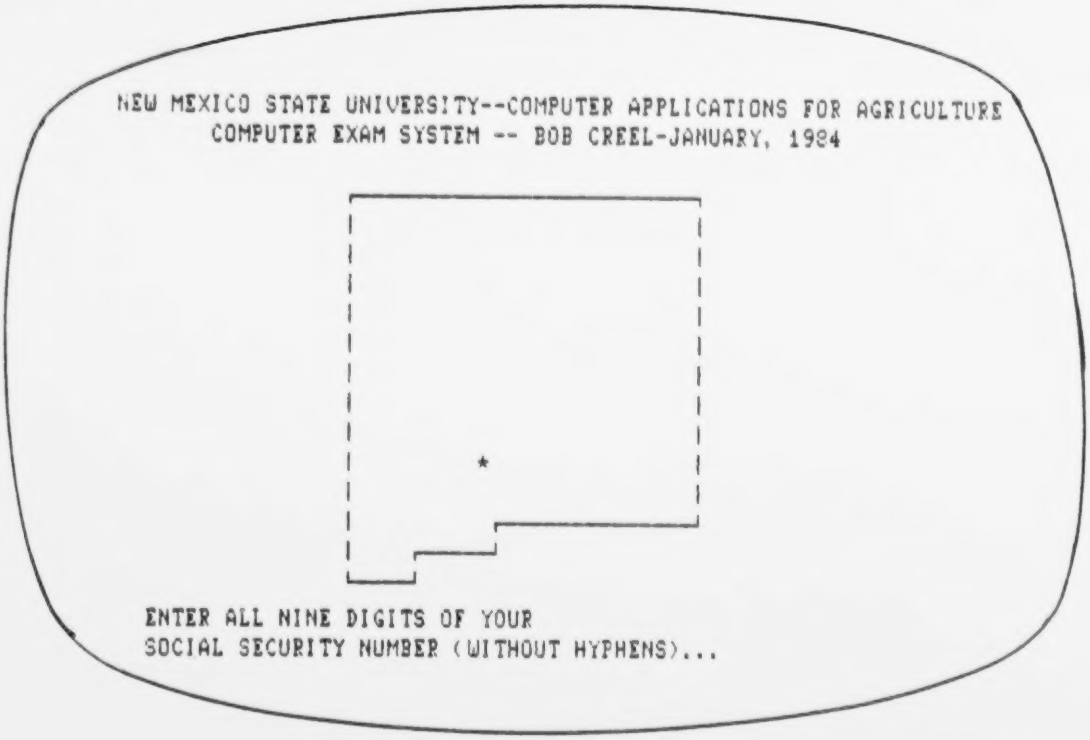
Purpose of Exams

The primary purpose of an examination is generally to measure the retention of material presented and provide the instructor with a measure of student performance. It is also desirable that examinations serve as learning tools. If students can be provided with the results of their performance promptly, it is more likely that examinations will serve as learning tools. The computer provides a vehicle to both administer the examination to the student and also provide almost instant feedbacks.

Description of Exam Administering System

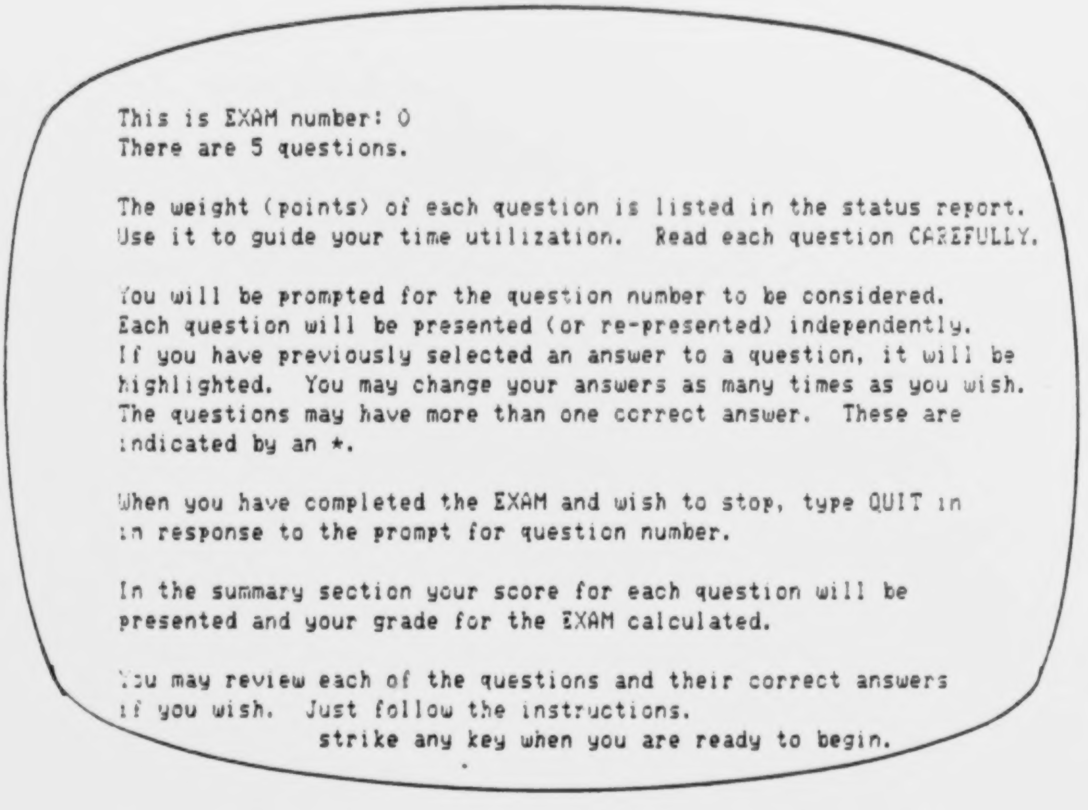
The exam administering system consists of computer programs which display a series of questions to the student, score the exam when the student has finished, allow the student to review the exam, and record the student's grade. Students gain access to the system with their social security number (figure 1). This can be used for security to prevent multiple attempts at an exam. Having accessed the system, students are presented with instructions or special information for the exam. Figure 2 shows an example of an instruction page. Multiple pages of instruction are possible. After the instructions, a status page is presented which provides the weight (points) of each question and whether or not the question has been answered or not (figure 3). Each examination can include up to 40 questions. Questions are displayed individually for consideration. The status page is represented following each question. Students can select the questions in any order, thus allowing them to address the more heavily weighted questions first. An example of a question display is shown in figure 4. The questions can be randomly selected from a bank of questions or the same set of questions can be administered to each student. The students can return to any question previously answered to check their answers as many times as they wish. The answers that they previously selected are indicated. This allows the students to review and check all their answers before they quit.

Once students have finished the exam, the system records all of their answers and scores the exam. They are presented with a status page which contains their answers to each question, the correct answer, and the score for each question as well as the overall score (figure 5).



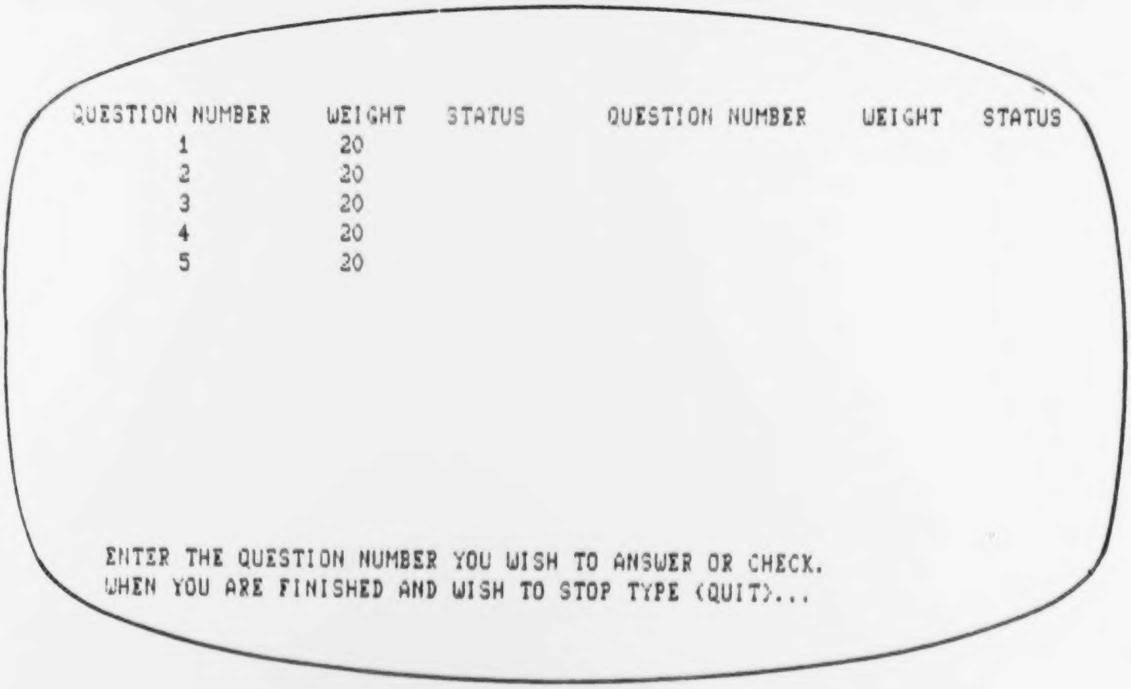
```
NEW MEXICO STATE UNIVERSITY--COMPUTER APPLICATIONS FOR AGRICULTURE
      COMPUTER EXAM SYSTEM -- BOB CREEL-JANUARY, 1984

 ENTER ALL NINE DIGITS OF YOUR
 SOCIAL SECURITY NUMBER (WITHOUT HYPHENS)...
```

Figure 1. Computerized Exam System screen display for access.



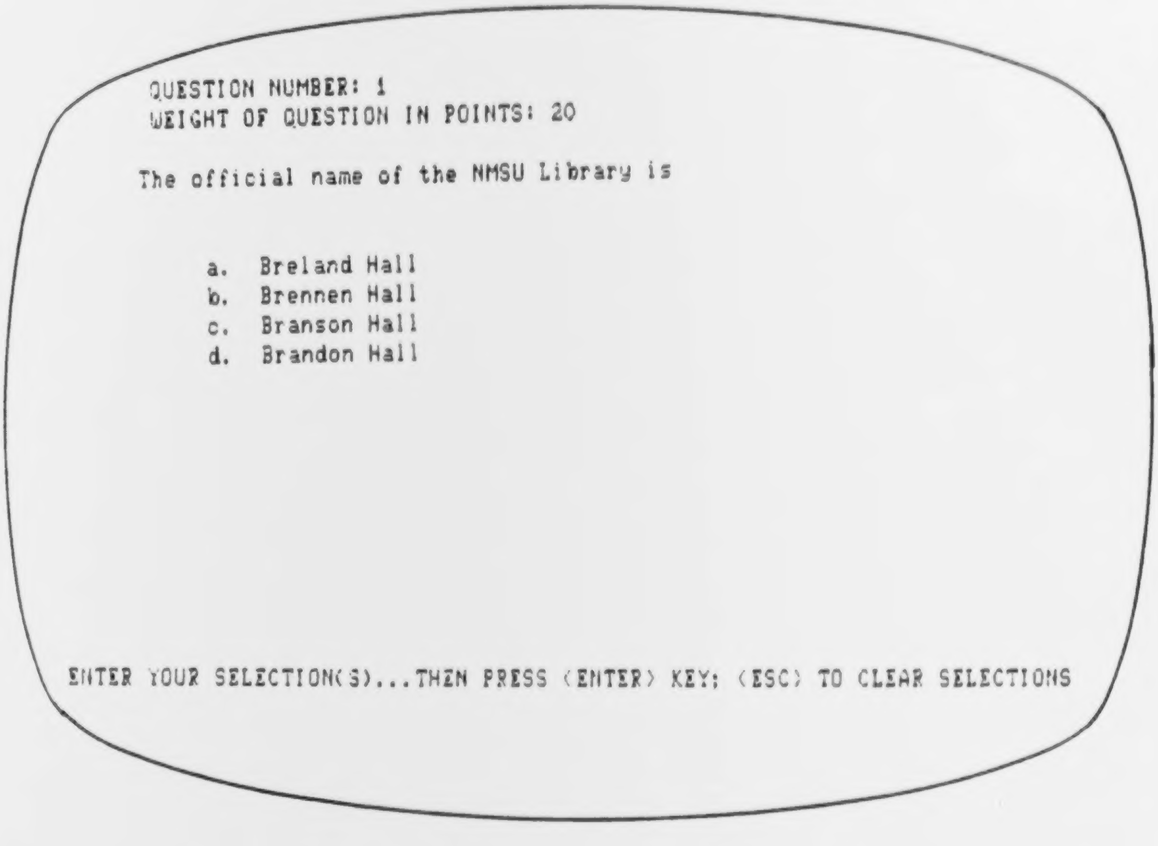
```
This is EXAM number: 0
There are 5 questions.

The weight (points) of each question is listed in the status report.
Use it to guide your time utilization.  Read each question CAREFULLY.

You will be prompted for the question number to be considered.
Each question will be presented (or re-presented) independently.
If you have previously selected an answer to a question, it will be
highlighted.  You may change your answers as many times as you wish.
The questions may have more than one correct answer.  These are
indicated by an *.

When you have completed the EXAM and wish to stop, type QUIT in
in response to the prompt for question number.

In the summary section your score for each question will be
presented and your grade for the EXAM calculated.

You may review each of the questions and their correct answers
if you wish.  Just follow the instructions.
              strike any key when you are ready to begin.
```

Figure 2. Computerized Exam System instruction page display.



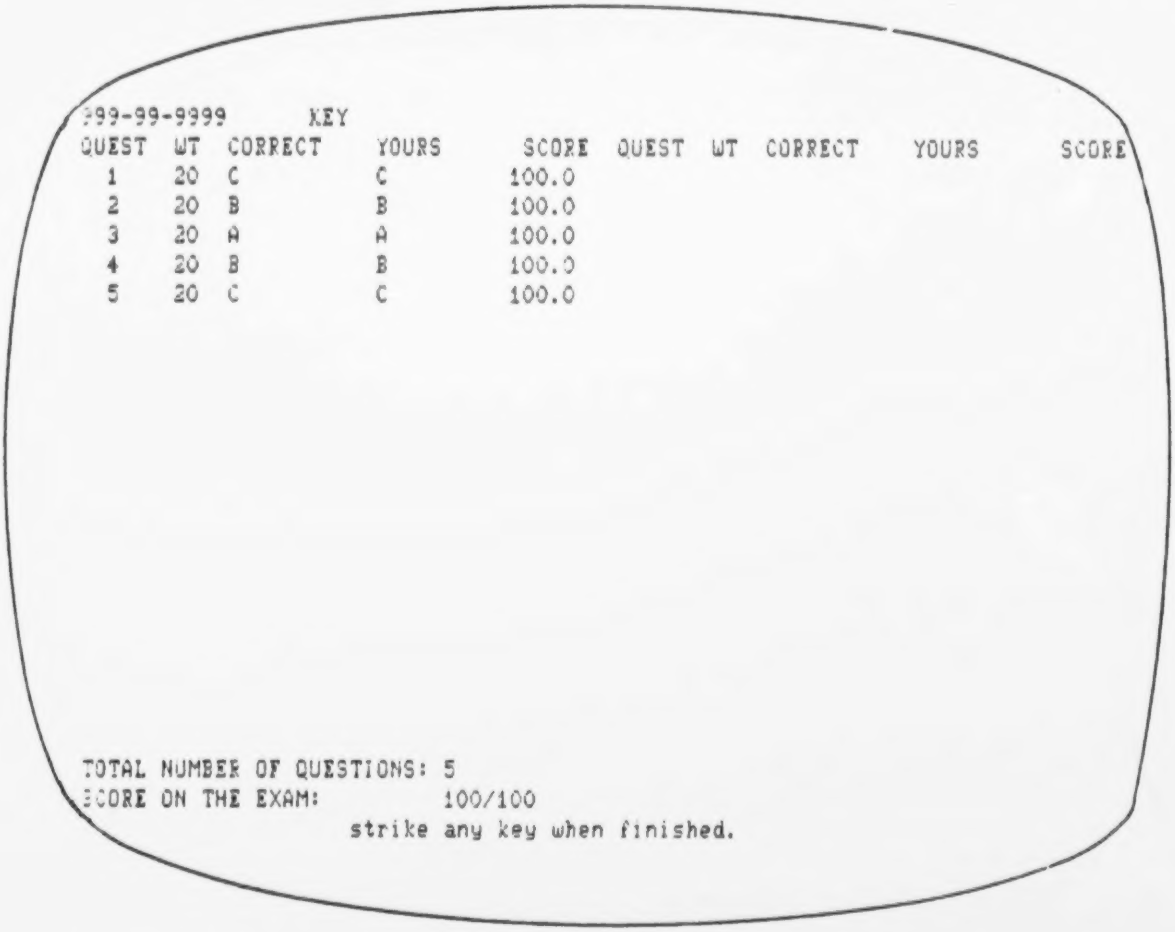
```
QUESTION NUMBER    WEIGHT  STATUS     QUESTION NUMBER    WEIGHT   STATUS
       1             20
       2             20
       3             20
       4             20
       5             20

ENTER THE QUESTION NUMBER YOU WISH TO ANSWER OR CHECK.
WHEN YOU ARE FINISHED AND WISH TO STOP TYPE <QUIT>...
```

Figure 3. Computerized Exam System status page display.



```
QUESTION NUMBER: 1
WEIGHT OF QUESTION IN POINTS: 20

The official name of the NMSU Library is

     a.  Breland Hall
     b.  Brennen Hall
     c.  Branson Hall
     d.  Brandon Hall

ENTER YOUR SELECTION(S)...THEN PRESS <ENTER> KEY; <ESC> TO CLEAR SELECTIONS
```

Figure 4. Computerized Exam System example question display.



```
999-99-9999      KEY
QUEST  WT  CORRECT    YOURS      SCORE  QUEST  WT  CORRECT    YOURS      SCORE
  1    20  C          C          100.0
  2    20  B          B          100.0
  3    20  A          A          100.0
  4    20  B          B          100.0
  5    20  C          C          100.0









TOTAL NUMBER OF QUESTIONS: 5
SCORE ON THE EXAM:          100/100
                    strike any key when finished.
```

Figure 5. Computerized Exam System final status page display.

Students can then elect to review the examination. The questions can be reviewed in any order the student desires. Their answers are noted as well as the correct answers. None of the answers previously provided can be changed at this point.

A number of machines can be utilized to administer the exam simultaneously. The system provides a program that compiles the information from a number of diskettes onto one file for the instructor for transfer to a gradebook.

Advantages of the Computerized Exam Administering System

The system provides a number of advantages both for the instructor as well as the student. The major advantage for the students is the prompt feedback on performance. Students are provided with their score and an opportunity to review the exam before they leave the room. The system also allows a printed version of the exam to be generated for each student with their answers and the correct answers to each question. This hard copy of the examination can be made available to students at the next class meeting.

A potential advantage for the instructor is that the instructor can devote more time to exam construction rather than to the administering and grading of exams. Additionally, scoring mistakes and biases the instructor exhibits are eliminated or reduced.

Individualized exams also reduce the potential for cheating. The system also provides a detailed analysis of the results of an exam which helps to eliminate poor questions and to identify any weaknesses in instructional presentations. The overall score for each question is provided as well as the three most prevalent wrong answers.

Limitations of a Computerized Exam Administering System

Any system for administering examinations has limitations or disadvantages. Currently, the system is limited to questions of the multiple-choice or true/false type. Essay questions cannot be scored. Start-up and learning time for the instructor to utilize the system is also required. Administering exams by computer also requires that students have ready access to machines capable of using the system. Students may feel intimidated with a computer giving them an exam, especially if they have no previous experience with a machine. The system is also subject to problems such as machine malfunction, loss of electrical power, and others.

Summary

The primary purpose of an examination is generally to measure student performance. A computerized exam administering system also provides almost instant feedback to students which allows it to serve as a learning tool. This system has been in use in both a sophomore and junior class in computer applications for three semesters. Students using the system generally like it. It has undergone a number of revisions during this time incorporating suggestions from students. The ability of students to review the exam and the time-saving features for the instructor outweigh the limitations associated with such a system.

The Computerized Student Gradebook

One of the time-consuming processes a teacher faces is that of keeping a gradebook. The use of a computer is ideal for this task. A program to store grades and to make the necessary calculations would be most useful to instructors and students.

Computer Gradebooks

There are several options available to those wanting to use computers to facilitate the grade keeping process. One type of program is the batch program such as that developed by Downey and Taylor. This system requires the user to record the grades and other data on cards or card images. The input data are then submitted to the computer along with the gradebook program. This system gives the user a great deal of control over the program, but generally requires some knowledge of the programming language.

Tice developed an interactive program for use on a micro-computer. An interactive program prompts the user with messages when input is needed. Interactive programs require a minimum of computer knowledge. The Computerized Student Gradebook (CSG) is an interactive program.

For programmers who desire the maximum in flexibility but have a limited knowledge of computers, a spreadsheet, such as Visicalc or Lotus 1-2-3, available on micro-computers is a good option (Burton). The main disadvantage of this option is that most instructors will probably not generate as much useful information for themselves or the students as with the other options.

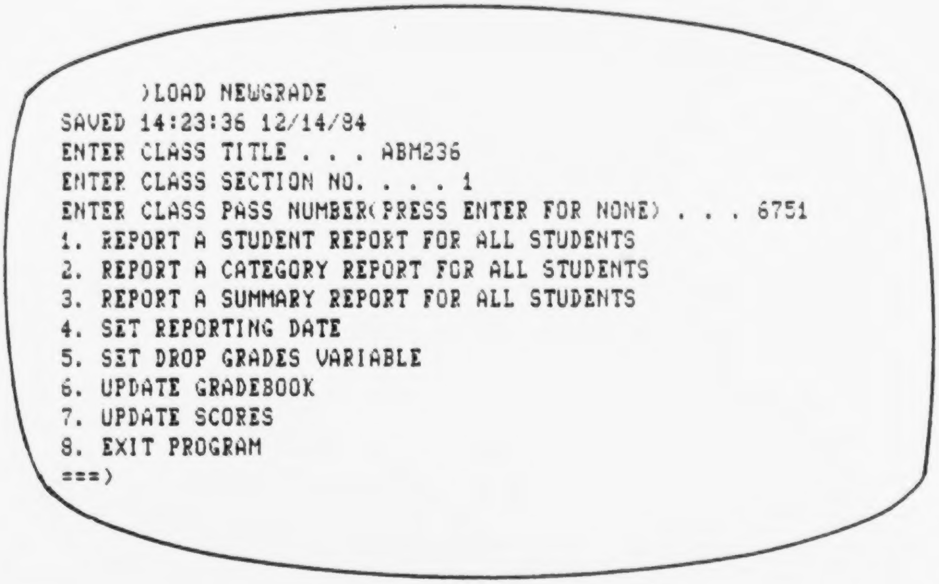
Purpose of Grade Reporting

The primary purpose of the gradebook is to record student grades. However, there are several other important functions which a gradebook reporting system should perform. For instructors, the system should make calculation of the final score as simple as possible. For an instructor who gives exams, quizzes, homeworks, laboratories, etc., the calculation of a final grade can be quite time consuming. The system should also report the final grade so that it is easy to assign a letter grade to the student or to fit the grades to a curve, if that is desired. For the student, grades should be reported often in order that the student and the instructor may monitor the student's progress. It is important, especially to students, that grades be reported accurately. And finally, students should have a good understanding of the method by which their grade is calculated. The CSG was designed with these factors in mind.

Description of the Computerized Student Gradebook

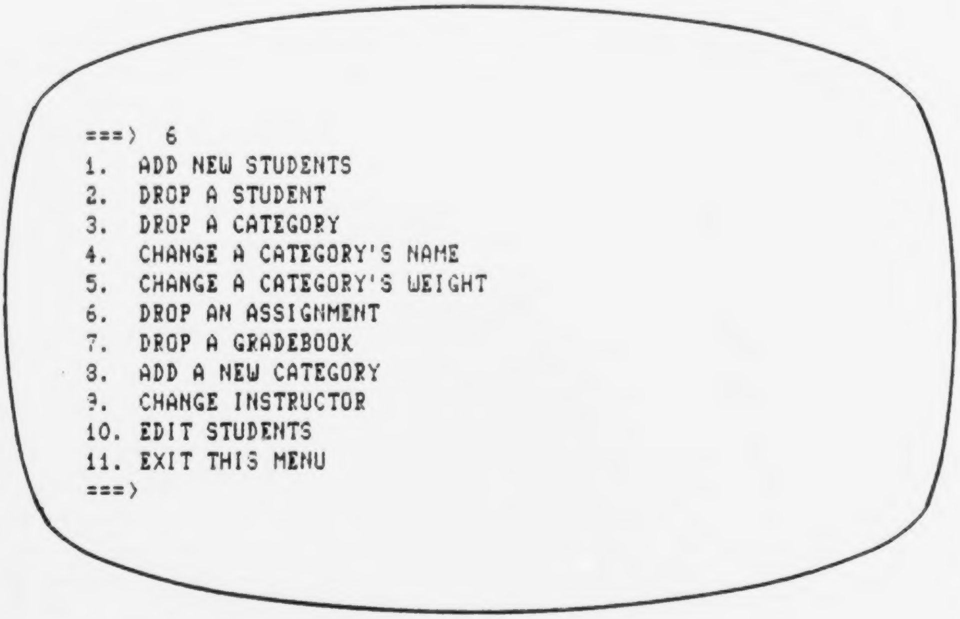
The CSG is an interactive program which can be used on either a micro or mainframe computer. Because it is an interactive program, very little knowledge of the computer is needed. The program is menu driven so that whenever input is needed from the user, a message appears on the screen informing the user of what is needed and the format for entry. This method reduces the number of data entry errors and diagnosis of the error is immediate. The main menu (figure 6) gives the user the choice of printing several reports, updating the gradebook, or updating student scores. Once the user has made a selection from the menu, another menu would appear (figure 7). This process of branching occurs until the user reaches the end of a branch and makes the desired entry, which may be changing a student's score or changing a student's name which was misspelled.

The program is designed to allow instructors to have an unlimited number of categories, such as exams, quizzes, homeworks, laboratories, and cases. The instructor assigns weights to each category, which must sum to one. The user must enter the name and social security number of each student. To enter grades, the user must specify the category for which grades will be entered and the maximum points possible for that



```
    )LOAD NEWGRADE
SAVED 14:23:36 12/14/84
ENTER CLASS TITLE . . . ABM236
ENTER CLASS SECTION NO. . . . 1
ENTER CLASS PASS NUMBER(PRESS ENTER FOR NONE) . . . 6751
1. REPORT A STUDENT REPORT FOR ALL STUDENTS
2. REPORT A CATEGORY REPORT FOR ALL STUDENTS
3. REPORT A SUMMARY REPORT FOR ALL STUDENTS
4. SET REPORTING DATE
5. SET DROP GRADES VARIABLE
6. UPDATE GRADEBOOK
7. UPDATE SCORES
8. EXIT PROGRAM
===)
```

Figure 6. Computerized gradebook system main menu display.



```
===)  6
1.  ADD NEW STUDENTS
2.  DROP A STUDENT
3.  DROP A CATEGORY
4.  CHANGE A CATEGORY'S NAME
5.  CHANGE A CATEGORY'S WEIGHT
6.  DROP AN ASSIGNMENT
7.  DROP A GRADEBOOK
8.  ADD A NEW CATEGORY
9.  CHANGE INSTRUCTOR
10. EDIT STUDENTS
11. EXIT THIS MENU
===)
```

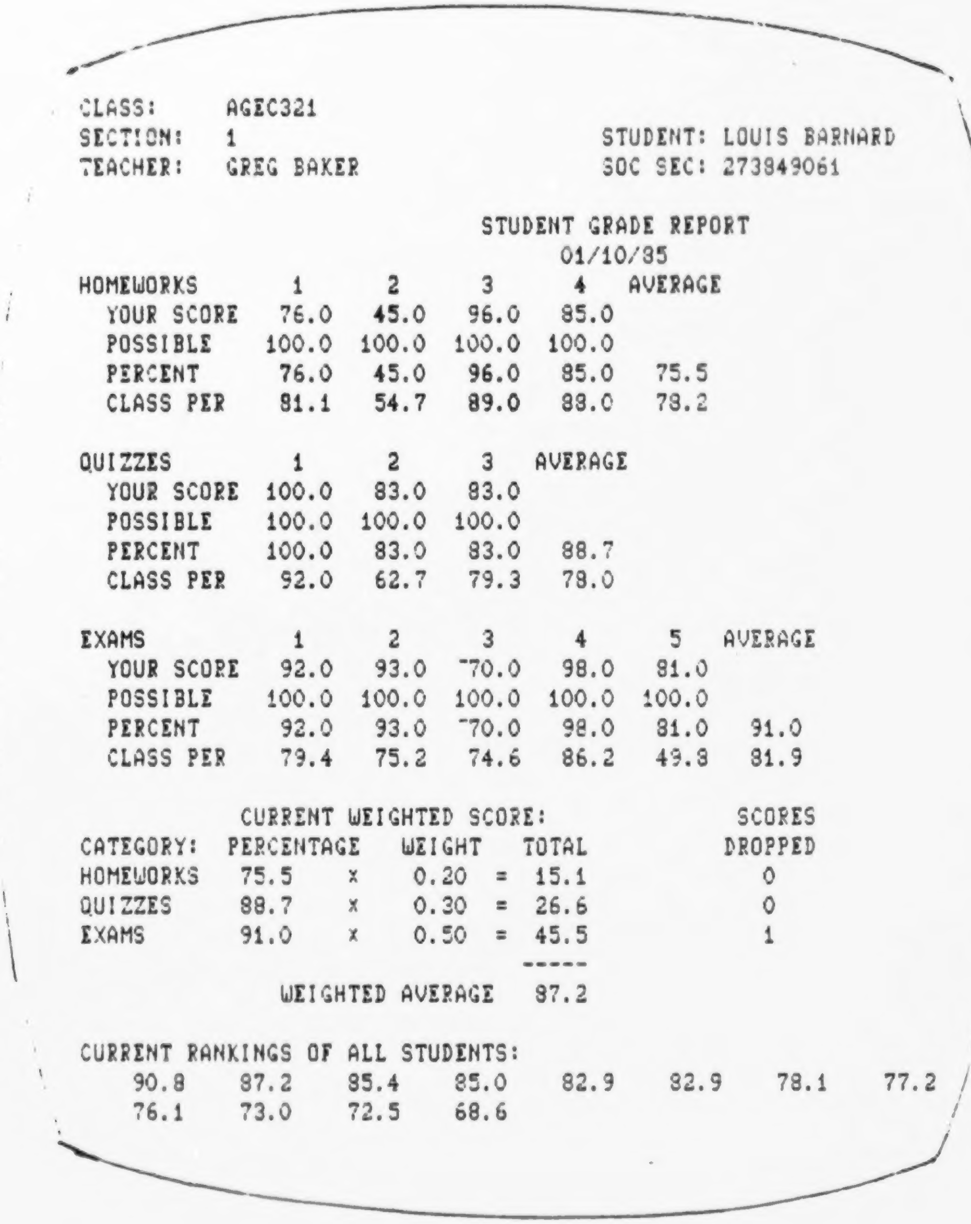
Figure 7. Computerized gradebook system submenu display.

entry. The computer then prompts the user with a student name and the instructor enters the student's grade. The instructor may assign excused absences to a student, which means that the grade will not enter into any calculations. Anything entered by the user may be edited. This may be a student name or social security number, a category name or weight, the instructor name, or a particular score. A major time-saving feature of the program is the ability to drop the lowest grade in a category. The instructor may allow students to drop their lowest exam grade, for example. The program will then scan all exam scores and omit the lowest one from consideration in computing the exam average. This omits the time-consuming process of visually scanning the scores for the lowest percentage and recalculation of the category and weighted total average. It also reduces the number of errors which may occur when this is done by hand. The number of categories, students, or scores per student is limited only by the available storage space on the computer.

Students receive a report with the following information (figure 8):

1. All of their scores in every category, both in raw and percentage terms.
2. The class average for every score.
3. Their average for a category.
4. Their weighted total average.
5. The weighted average of all students' scores (without student identification) in descending order.

This report gives students a permanent record of every grade they have earned in the class. This helps to eliminate errors in recording the grades. Students may evaluate their progress in the course with respect to standards set forth by the instructor or in relation to the progress



```
CLASS:     AGEC321
SECTION:   1                          STUDENT: LOUIS BARNARD
TEACHER:   GREG BAKER                 SOC SEC: 273849061

                                  STUDENT GRADE REPORT
                                        01/10/85
HOMEWORKS       1      2      3      4   AVERAGE
  YOUR SCORE  76.0   45.0   96.0   85.0
  POSSIBLE   100.0  100.0  100.0  100.0
  PERCENT     76.0   45.0   96.0   85.0   75.5
  CLASS PER   81.1   54.7   89.0   88.0   78.2

QUIZZES         1      2      3  AVERAGE
  YOUR SCORE 100.0   83.0   83.0
  POSSIBLE   100.0  100.0  100.0
  PERCENT    100.0   83.0   83.0   88.7
  CLASS PER   92.0   62.7   79.3   78.0

EXAMS           1      2      3      4      5  AVERAGE
  YOUR SCORE  92.0   93.0  ¯70.0   98.0   81.0
  POSSIBLE   100.0  100.0  100.0  100.0  100.0
  PERCENT     92.0   93.0  ¯70.0   98.0   81.0   91.0
  CLASS PER   79.4   75.2   74.6   86.2   49.8   81.9

           CURRENT WEIGHTED SCORE:                SCORES
CATEGORY:  PERCENTAGE   WEIGHT   TOTAL            DROPPED
HOMEWORKS  75.5    x     0.20  =  15.1              0
QUIZZES    88.7    x     0.30  =  26.6              0
EXAMS      91.0    x     0.50  =  45.5              1
                                -----
              WEIGHTED AVERAGE   87.2

CURRENT RANKINGS OF ALL STUDENTS:
    90.8     87.2     85.4     85.0     82.9     82.9     78.1     77.2
    76.1     73.0     72.5     68.6
```

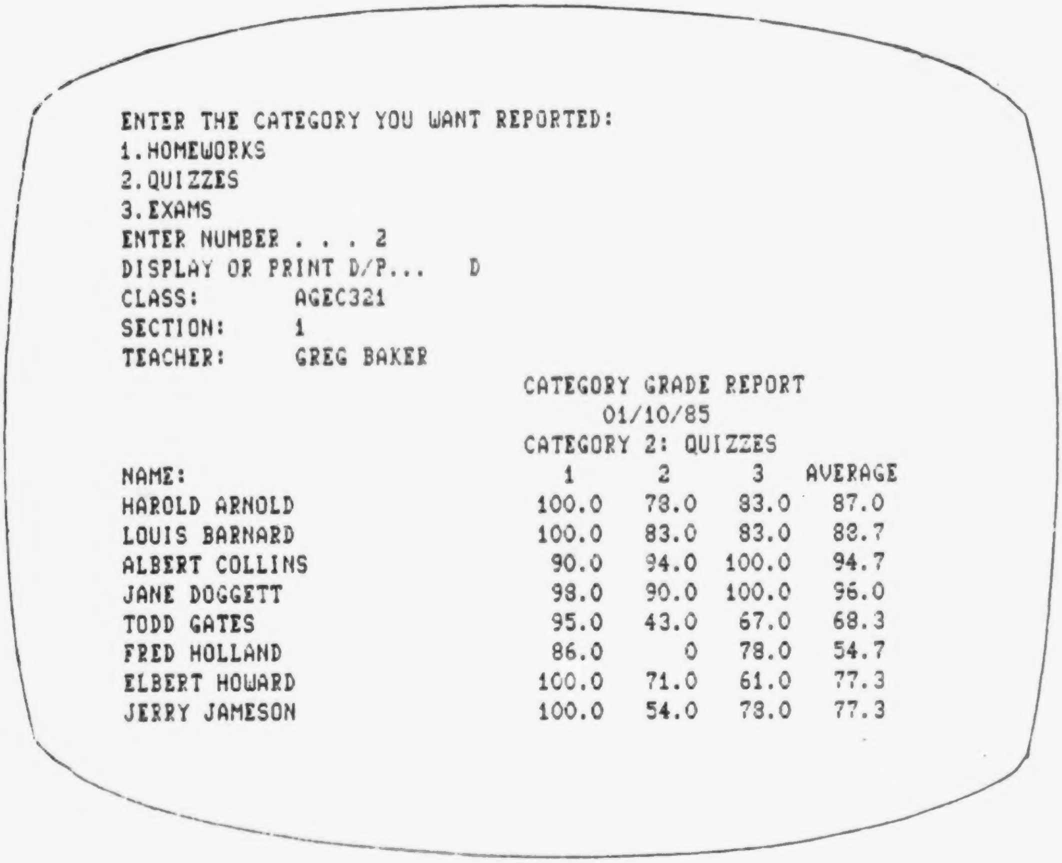
Figure 8. Computerized gradebook system student report display.

of their fellow students. Instructors may give the students this feedback at important times throughout the semester, such as before the final day to drop a class or before an important exam.

An additional feature available when using a mainframe computer is that students with access to a computer account may access their report at any time simply by loading a copy of this report. For security reasons, the students see only a copy of their report and not the original. To prevent anyone from having access to a student's report, the students must use their social security number to receive the report. In addition to allowing the instructor more flexibility as to the number of student reports to hand out, the feature may be used to encourage student use of the computer.

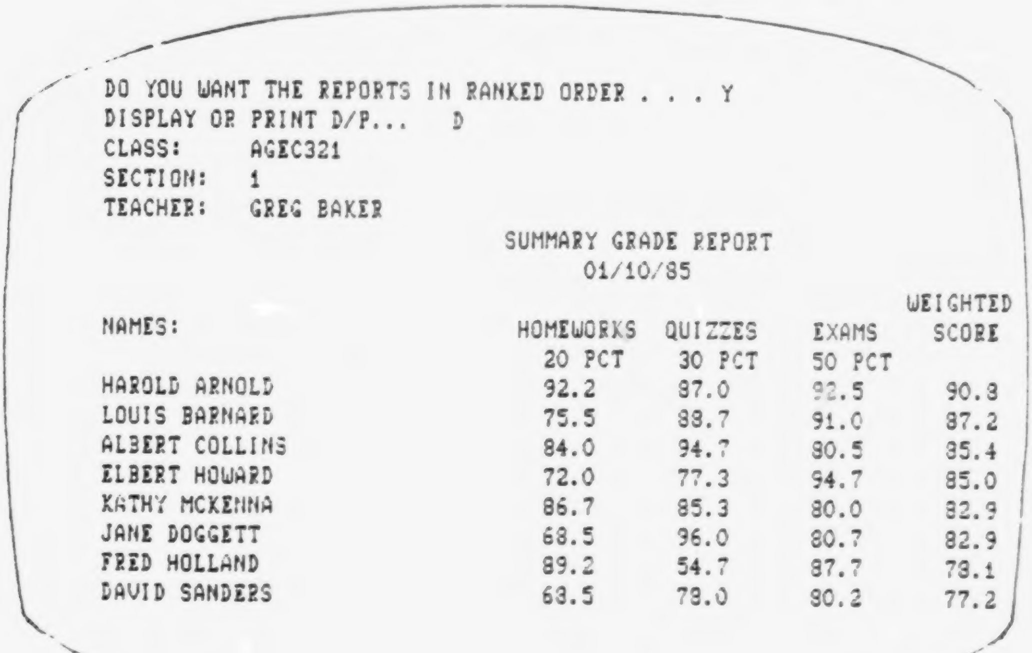
Another feature used in conjunction with computer accessed reports is a program which calculates for students (or instructors) the grade a student needs on the final exam to receive a certain grade in the course. For example, if 90 percent was the cutoff for an A, a student might ask, "What grade will I need in the last exam to receive a weighted average of 90 percent in the course?" This is time saving for both the student and the instructor.

Instructors may receive two types of reports, category reports (figure 9) and a summary report (figure 10). The category report shows every score for a student in a category and the student's average. For example, if an instructor gave three exams, the exam category report would contain the score for each student on all three exams and the average. There is a category report for each category the instructor uses.



```
ENTER THE CATEGORY YOU WANT REPORTED:
1.HOMEWORKS
2.QUIZZES
3.EXAMS
ENTER NUMBER . . . 2
DISPLAY OR PRINT D/P...   D
CLASS:        AGEC321
SECTION:      1
TEACHER:      GREG BAKER
                                 CATEGORY GRADE REPORT
                                       01/10/85
                                 CATEGORY 2: QUIZZES
NAME:                               1       2       3    AVERAGE
HAROLD ARNOLD                   100.0    78.0    83.0     87.0
LOUIS BARNARD                   100.0    83.0    83.0     88.7
ALBERT COLLINS                   90.0    94.0   100.0     94.7
JANE DOGGETT                     98.0    90.0   100.0     96.0
TODD GATES                       95.0    43.0    67.0     68.3
FRED HOLLAND                     86.0       0    78.0     54.7
ELBERT HOWARD                   100.0    71.0    61.0     77.3
JERRY JAMESON                   100.0    54.0    78.0     77.3
```

Figure 9. Computerized gradebook system instructor category report display.



```
DO YOU WANT THE REPORTS IN RANKED ORDER . . . Y
DISPLAY OR PRINT D/P...   D
CLASS:      AGEC321
SECTION:    1
TEACHER:    GREG BAKER
                                 SUMMARY GRADE REPORT
                                       01/10/85
                                                                WEIGHTED
NAMES:                          HOMEWORKS  QUIZZES    EXAMS      SCORE
                                  20 PCT    30 PCT    50 PCT
HAROLD ARNOLD                      92.2      87.0      92.5       90.8
LOUIS BARNARD                      75.5      88.7      91.0       87.2
ALBERT COLLINS                     84.0      94.7      80.5       85.4
ELBERT HOWARD                      72.0      77.3      94.7       85.0
KATHY MCKENNA                      86.7      85.3      80.0       82.9
JANE DOGGETT                       68.5      96.0      80.7       82.9
FRED HOLLAND                       89.2      54.7      87.7       78.1
DAVID SANDERS                      68.5      78.0      80.2       77.2
```

Figure 10. Computerized gradebook system instructor summary report display.

The summary report gives the instructor each student's average for a category and the student's weighted average for the course. The students may be listed in the order in which they were entered or they may be ranked by their weighted average. By ranking the students, it makes it much easier to fit the grades to a curve, since the effect of using different cutoffs may be easily observed.

Advantages of the Computerized Student Gradebook

For students, the major advantage of the CSG is that they will be better informed as to how their grades are computed and of their progress in the course. Their progress may be evaluated relative to standards set forth by the instructor or to the performance of the class as a whole, since this information is available to them. Since they have a permanent record of all of their scores, any errors made in the recording of their grades are more easily noticed. Timely use of the program and distribution of the printouts will ensure that students are aware of their performance at important times such as before class drop dates and important exams. Students also have access to their reports at any time and the system may be used to encourage student use of the computer. The program also saves time since students and instructors may use the program to determine what they need on the final exam to reach a cutoff grade in the class.

Instructors will benefit by spending less time calculating grades. They can make a great deal of information available to students and spend less time doing it than with a traditional gradebook. Two of the major time-saving features of the program are that it performs all calculations and that the lowest score (or scores) in a category may be dropped. If timely use is made of the student reports, no student should complain that he or she was misinformed of his grade. Assigning grades is much easier since all students' weighted average grades are printed out, ranked by weighted average if desired.

Disadvantages of the Computerized Student Gradebook

A disadvantage of the CSG is that some learning time is required to use the CSG. However, because the program is interactive and a system of menus is used, the little time necessary to learn the program should easily be recaptured after using it two or three times. It is also possible to lose data because of malfunctions in hardware or because of the system going down unexpectedly. A computerized gradebook is not a substitute for the traditional gradebook, but can be a very useful supplement. As a matter of security, both should be used. Another problem is that when using a mainframe computer, one has little control over use of the computer or printer. And, although the CSG was written to allow the maximum in flexibility, the user must still operate within the limits of the program and the computer.

Summary

One of the time-consuming tasks that an instructor faces is that of keeping a gradebook. A number of computerized gradebook programs are available, but these have a number of limitations. The CSG system provides a user-friendly environment with many options unavailable in other systems. The benefits provided with the CSG system outweigh the costs associated with its use.

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References

Burton, Robert O., Jr, "A Computerized Gradebook: One Teacher's Experience," National Association of Colleges and Teachers of Agriculture Journal, June 1984.

Downey, W. David, and Robert W. Taylor, Student Grade Report, unpublished paper.

Tice, Thomas F., "Grade Recording and Statistics Program for Microcomputers," National Association of Colleges and Teachers of Agriculture Journal, December 1981.

A RETESTING ON DEMAND STRATEGY FOR GENERAL PHYSICS USING COMPUTER GENERATED PROBLEMS

by

A. F. Burr

New Mexico State University

A Retesting on Demand Strategy for General Physics Using Computer Generated Problems

A. F. Burr

Physics Department
New Mexico State University

This report will be divided into two parts. The first part will be concerned with the educational technique of multiple retesting. The second part will be concerned with the computer program and data base which makes the retesting technique feasible. This report and the whole project is of a practical rather than theoretical nature. The purpose of the project was to encourage learning rather than to investigate or develop some educational theory.

The course directly involved is a conventional one year non-calculus general physics course. It provides a standard treatment of mechanics, heat, sound, electricity, magnetism, light, and modern physics. The course is divided into two semesters of three credits each. There is a one credit hour per semester laboratory associated with, but not a part of, the course. The ideas and findings developed during this project should be just as applicable to any similar course. That is, the mathematical level, the subject matter level, or even the subject matter itself does not play an important role in the study. Any course which could use a test of the type used in this study would be suitable for the techniques described here.

The Grading Scheme Used for the Course

Grades were assigned at the end of the semester in such a way that the average was a high C and the distribution approximately normal. Three factors made up the final marks: homework (10%), three hour tests (70%), and a one hour comprehensive final test (20%). All components of the final grade are similar. The homework consists of standard problems selected from the problems given at the end of the Chapters of the text. During the semester, three hour tests were given at approximately four week intervals. These tests covered only the material studied since the previous test. A comprehensive final was administered at the last class meeting of the semester. The questions on all the tests were all of the same type as the homework problems. They contained no true or false, multiple choice, or short answer type of questions.

The retesting program basically offered to any student the opportunity to take another test over the same material as any previous hour test. These retests could be taken at any convenient time. As many retests as the student wanted were offered.

Retesting as an Educational Strategy

Some people ask why should one test at all. Most teachers consider tests to be a necessary, if not always a good, feature of most courses. Three often used reasons for testing are

1. A direct and immediate incentive for the student to study.

2. An opportunity to integrate and organize the knowledge gained from the course.

3. To provide a basis for grade assignment.

Retesting

Retesting over the same material is a technique which is a little more controversial than testing itself. A number of arguments are put forward in favor of retesting over old material.[1,2] The two main ones are greater mastery of the subject matter by the students and a more relaxed attitude on the part of the students. The students also have a greater incentive to study. The retesting process also provides for automatic make-up tests for those students who are absent. Students often claim they have not been given enough points or that the test question selection was not fair. These students can be simply told that, if for any reason they think their grade does not fairly represent their knowledge, they can ask for a retest.

There are some legitimate arguments against retesting. One of the most telling is that it is more work for the instructor. It also increases the chance of system manipulation by the student. It forces another choice on the student and may reduce the seriousness with which the student regards the regular tests. Some people[3] object that the procedure allows students of marginal intellect to get higher grades and even some students object to the curve raising aspects of the strategy.

This experience has shown me that students do study more and learn more. The extra work can be manageable also. Students do try to manipulate the system to their advantage. An unexpected bonus was the almost entire disappearance of some problems. I no longer had to worry about doctor's excuses, funerals for dead aunts, or other possibly fabricated excuses for missed tests. Neither did I have to argue about the sufficiency of part credit for problems not completely botched. The fairness of problem selection could no longer be effectively questioned. The one all purpose response to all the difficulties was "At what time would you like to take the retest?"

Details

There are a number of details which have to be considered if any program of extensive retesting is to be successful. The first to be settled is the manner in which retest scores are to be counted. Discussed here are four ways of handling this problem. They are listed in my order of preference.

I prefer to record the last test score. Of course this procedure means that a student will not improve his class standing if his retest score is lower than his original score. This element of risk reduces frivolous retesting and reduce the tendency to take as many tests as possible in the hopes that one lucks out on one and gets a high score.

Strictly speaking a good case can be made for the use of the average of the original plus all the retests. In this way you make use of all the information available. You prevent the student from underestimating the importance of the first test. If, after a disastrously low first score, the material is truly learned so that high scores are routinely obtained, the final score can still be raised to any desired value by amassing a number of high scores to offset the original low one. From a practical standpoint, however, it is a little selfish to demand that much time of a student at the expense of his other courses.

Some teachers feel that they are being generous if they award 50% of the improvement generated by retests. There are some philosophical difficulties with this procedure. One hopes that the tests measure the knowledge the students have of the physics course. The purpose of the course is to teach physics. The course is not an intelligence test or a screening device for various occupations or other courses. If a student passes a test showing he now knows the material he should not be penalized for his previous ignorance.

The students would prefer to be awarded the points for the highest score made regardless of areas of ignorance uncovered by subsequent tests. That method leads to too many students taking tests on speculation. It increases the workload and decreases the built-in incentives for study before the test.

The question of part score for problems incorrectly solved because of a minor arithmetic or other error is a serious one. With all the retests given and the different problems posed, there just is not enough time to locate the error which a student has made. A good case can be made for the all or nothing approach to the grading of problems. If one is designing a bridge and one comes up with a good design except for the fact that the decimal point is off by only one place, you are still going to get fired, and sued, when the first truck across it falls through. Nevertheless I find it difficult not to give part credit so I throw in a few points for the correct units or the prominently displayed correct physical principle. I have to force myself not to try to locate the students error because I would have to steal the time required from other activities which the University, my department head, and I consider important. This problem is serious, however, and is the biggest cause of student dissatisfaction with the retesting procedure.

There are a number of housekeeping problems. One has to find places to set the students while they take the retest. To put many in the same room would require supervision. The constant interruption of other tasks by students asking for retests decreases efficiency. Many of these problems are solved by asking the students to sign up for one of six specific times during the day. Then the number at a time is limited to the number of testing places available. To allow time for study, a maximum of one retest per week is permitted. The tests are never graded immediately and the student must make a demonstratable effort to find his or her error before the answers are discussed with them individually.

Cheating, especially in the form of a small crib sheet containing equations, is a possibility because all these retests cannot be supervised individually. An attempt to look in on each student at some random time is made but a student determined to cheat could. All work is required to be turned in with the answer. Few suspiciously high scores have been seen.

Results

The program of multiple retests has been used for three semesters. Table 1 summarizes some of the results that have been obtained.

The interpretation of these statistics is obscured a bit by the fact that for two of these semesters the last test score was the one counted while for the other semester it was the average which was used. With the latter method of scoring the number of students requesting retests, the number of retests given, and the improvement in test scores were all about one half of the corresponding statistic for the semester in which the last test was the one which counted. These results are consistent with results reported from somewhat similar projects.[4]

All the students were encouraged, but not required, to comment on the retesting procedures with the results shown in Table II. The students were very enthusiastic about the program. There were comments like "Great Idea!", "best part of the course". Of those who explained their dislike of the program, two said they had no time for the retests and five said they resented the fact that those with more time to study could improve their relative class ranking at the expense of those without the time.

My subjective observations make me an enthusiastic supporter of the program. The amount of time spent studying physics clearly increased. The number of intelligent questions asked in and after class increased. Fewer students gave up trying to master earlier concepts, and the number of arguments over test grading decreased.

The Computerized Tests

The availability of computer generated tests is the feature which made the retesting program possible. Without them, it would have been impossible to find the time to create and grade the tests. A computer program was written which randomly selected a prescribed number of questions (usually four) from a prescribed portion of a previously entered data base. The questions were assembled into a test complete with a unique serial number and a place to write the answer.

Each of these questions consisted of a problem, for which there was usually a numerical answer, of the same type as were given for homework. The numerical value of one or more of the variables in the problems was selected at random by the computer from a previously designated range. Thus even with a small data base there was no possibility of two identical tests.

The computer also calculated the answer to each particular problem and printed it, complete with identification and appropriate units, right beside the space which it provided for the student's calculated answer. The list of answers is printed on a part of the page separated from the test by perforations. The answer list is also identified by the same serial number assigned to the test. Figure 1 shows part of a typical test.

Just before the test is given to the student, the answers are torn off. Then at the end of the day all one has to do is match the tests to the answer sheets and compare the response of the student with the results provided by the computer. Time does not permit the details of the work which the student is required to turn in with the test to be checked for part credit. Often, though, a small bit of credit can be quickly given for correct units.

The Data Base

The data base was created by typing into a special file in the computer problems from the back of the chapters of the text.

Although the project is not yet complete, enough problems have been entered to provide a reasonable selection for each chapter. Figure 2 shows a typical problem as entered into the data base. Each problem has the same six parts as shown in the figure.

The first part is the problem identifier. The first number (here 02) is the chapter number. The second (here 01) is the section number. The third (here 2) is a serial number to ensure uniqueness. The three numbers which follow (here 2 1 1) denote, respectively, the number of variables for which the computer must supply random numbers, the number of parts to the question, and a number proportional to the estimated difficulty of the problem. The last number is a 1,2, or 3.

The next section consists of a line for each variable. The first entry is the symbol for the variable. The first of the string of numbers following this symbol is the lower limit of the range from which the random number is to be drawn. The next number is the upper limit of that range. The third number is the power of ten to which the random number is to be raised, that is it determines the location of the decimal point. The other three numbers are provided automatically by the computer and are used in the internal program.

The following section (set off from the rest of the problem by semi-colons) is the equation used by the computer to calculate the answer to the problem after it has selected all the required random numbers. This equation must follow rules similar to any instruction in FORTRAN or BASIC.

The next line contains whatever is to be printed in front of the numerical value on the answer sheet.

The next line contains whatever is to be printed after this numerical value. Usually it is the units of the answer.

The final part is the text of the problem itself. In this text the variables which are to be replaced with random numbers are represented by the symbol previously defined preceeded by an ampersand.

The Entry Program

A separate program was written to assist the person entering these parts of each problem into the data base. The keyboard operator is prompted to enter each of the parts discussed above. The operator has the option to enter the entire section at the first prompt. If this option is declined, the computer will prompt for each part of the section. A limited amount of error checking is provided, mostly consisting of recycling through the prompts if obviously inappropriate data is entered.

An overall check for correctness is provided. When the details of the random variables are entered, one of the prompts requests a sample value for the variable. After the equation is entered, the computer uses these sample values to calculate an answer. This answer is displayed and the operator is asked if it is correct or not. If it is, the computer goes on to the next operation. If it is not, the operator is given the choice of rewriting the equation or of abandoning this particular problem.

Because it takes some computing time to add problems to the data base the usual procedure is to collect new problems in a temporary file until a convenient time. Then the computer is instructed to add the temporary file to the main data base. The temporary file can be easily checked for errors and edited before being merged with the main file.

The Test Making Program

There is another program for actually making the tests. This program is also self-prompting so that persons without an extensive computer background can create tests easily. After telling the computer that one wishes some tests, the computer asks if instructions on running the test making program are desired. It then provides them or asks a series of questions which define the tests to be created. These questions are

Do you wish to:

1. Use a set of characteristics that you have previously saved?
2. Specify a new set of characteristics?

Enter the number of tests to be generated:

Enter the number of questions to be included in each test:

Do you want

1. To have the SAME questions on each test?
2. To have DIFFERENT questions on each test?

Enter the chapters to be covered on the test:

Chapter number ...

Enter any sections which MUST be included on the tests:

Enter any sections which MUST NOT be included on the tests:

Enter any questions which MUST be included on the tests:

Enter any questions which MUST NOT be included on the tests:

The answers to these questions can be filed in a test characteristic file for later use if desired.

Difficulties

There are a number of difficulties in creating the data base. The most important one is the difficulty of including even the simplist graphics. In practice this means that any problem which depends upon a figure for its solution cannot be included in the data base. Furthermore any problem which requires a figure for its answer will be more difficult to grade. Indeed most problems which cannot be answered with a numerical or short, well defined answer will be too time consuming to grade.

Another problem is raised by variables which are to be randomized. At first it was planned to randomize every numerical value which appeared in a problem; but this plan proved too time consuming (and unnecessary besides). First of all one must limit the range from which the computer selects a number for a variable. If this is not done, the correct answer to a problem may be unphysical in magnitude. Because every instructor would like the student to at least make sure that his answer is reasonable, it would be self-defeating to have the correct answer to the speed of a runner to be something like 127 meters per second. Thus if the question is something like "What is the average speed of a runner who covers 100 meters in 10.3 seconds?" cannot be randomized without thought. In this case one might ask the computer to select the time from the range 10 to 15. If both the time and the distance were to be randomized, somewhat more than twice the effort spent on radomizing one would have to be spent to keep the answer within reason. Furthermore each variable randomized required its own line in the entry program. Fortunately, in most cases it is only required to randomize one, or at most two, variables to change the problem enough to prevent students from getting credit for only memorizing a specific answer. Of course some problems, such as the addition of a number of vectors can have more variables easily randomized.

Yet another difficulty is caused by the requirement that the answer to each problem (or part of a problem) be represented by a single equation in the variables randomized. This equation has to be found, usually an easy task but sometimes time consuming. For example, when solving for the direction of the resultant of a sum of vectors, one usually takes the arc tan of the ratio of two previously calculated simple numbers, the sum of the x and y components. Here one cannot reduce the computer to numbers but must write them out as algebraic sums; a procedure which results in a long and unweilding acr tan equation.

For this project, a file of physical constants, such as the charge on the electron, was created so that they could be referred to be letters. It turned out that the complications introduced by the additional file were more than the convenience of not having to explicitly enter the constants into the equation for the problems.

Another problem was how to get the computer to print out powers of 10. The usual printer will not handle numbers such as 3.6×10^6 meters. Various printed forms such as 3.6x10E6 or 3.6E6 were tried. The latter form was selected because it is the usual form printed by computers and it proved to be easy to learn and recognize even by students with no previous computer experience.

In all the program has turned out rather successfully. It proved to be more difficult than expected to create the data base, but the tests are very easy to create and convenient to grade. The program could also be used to create new home work problems, each set to be slightly different from the other to prevent one answer from being used by several students.

References

1. David E. Golden, Robert G. Fuller, and Donald D. Jensen, Am. J. Phys. 42, 941-3 (1974).
2. David E. Golden, Robert G. Fuller, and Donald D. Jensen, Am. J. Phys. 43, 746 (1975).
3. John Lohr, Am. J. Phys. 43, 738-9 (1975).
4. James D. Edmonds, Am. J. Phys. 43, 745-6 (1975).

Table I. Retesting Statistics

Number of Students who could request retests	177
Number of Students Requesting Retests	149
Number of Retests Given	512
Retests per Student	29
Average Score Improvement	27
Average Percentage Increase	15

Table II. Student Comments

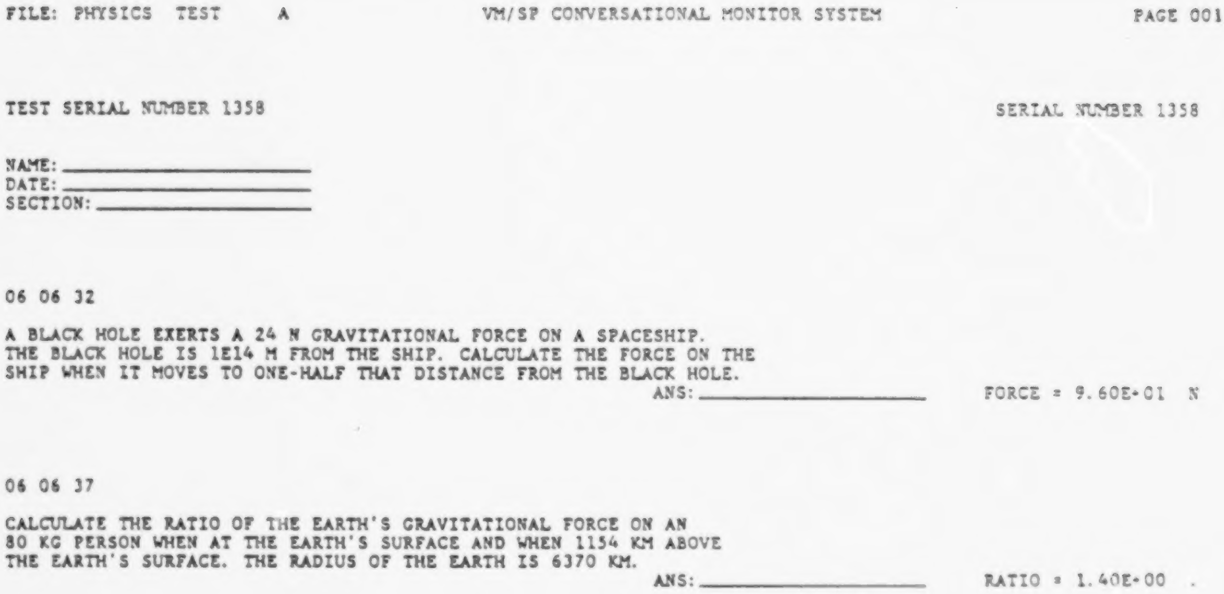
Did you like the retesting program?

Yes	91%
No	9%

Why?

A.	The retests were easier	8
B.	Was able to study more	51
C.	Felt less pressure	42
D.	Was able to guess which questions would asked	24
E.	Other	4

(Multiple answers permitted)



```
FILE: PHYSICS  TEST     A                 VM/SP CONVERSATIONAL MONITOR SYSTEM                      PAGE 001


TEST SERIAL NUMBER 1358                                                                  SERIAL NUMBER 1358

NAME: ______________________
DATE: ______________________
SECTION: ___________________


06 06 32

A BLACK HOLE EXERTS A 24 N GRAVITATIONAL FORCE ON A SPACESHIP.
THE BLACK HOLE IS 1E14 M FROM THE SHIP. CALCULATE THE FORCE ON THE
SHIP WHEN IT MOVES TO ONE-HALF THAT DISTANCE FROM THE BLACK HOLE.
                                                  ANS: __________________      FORCE = 9.60E+01  N


06 06 37

CALCULATE THE RATIO OF THE EARTH'S GRAVITATIONAL FORCE ON AN
80 KG PERSON WHEN AT THE EARTH'S SURFACE AND WHEN 1154 KM ABOVE
THE EARTH'S SURFACE. THE RADIUS OF THE EARTH IS 6370 KM.
                                                  ANS: __________________      RATIO = 1.40E+00  .
```

Fig. 1. Part of a typical test with the answer on a perforated section to the right.

```
02 01 2    2 1 1
        T1      2 9 0 1 0 2
        T2      2 9 0 1 0 4
      ;
         SQRT((T1 * 0.799 + T2 * 0.174) * (0.799 * T1 + T2 * 0.174) +
         (T2 * 0.985 -T1 * 0.602) * (0.985 * T2 - 0.602 * T1))
      ;
        FORCE =
        N
          A FORCE TABLE USED IN STUDENT LABORATORIES IN PHYSICS CLASSES
        HAS A RING TO WHICH THREE STRINGS ARE TIED.  THE FIRST TWO STRINGS
        EXERT THE FOLLOWING FORCES ON THE RING: T1 (&T1 N DIRECTED 37 DEGREES
        BELOW THE POSITIVE X AXIS) AND T2 (&T2 N DIRECTED 80 DEGREES ABOVE
        THE POSITIVE X AXIS.)  CALCULATE THE MAGNITUDE OF THE FORCE OF THE
        THIRD STRING ON THE RING IF IT REMAINS IN EQUILIBRIUM.
```

Fig. 2. Typical problem from the data base.

COMPUTER BASED SPECIAL EDUCATION TEACHER TRAINING

by

G. Phillip Cartwright

The Pennsylvania State University

COMPUTER BASED SPECIAL EDUCATION TEACHER TRAINING

G. Phillip Cartwright, Ph.D.
Professor and Head,
Division of Special Education and Communication Disorders
The Pennsylvania State University

Problem 1:

The Pennsylvania State University is a multi-campus institution with 20 Commonwealth or branch campuses in addition to the main campus. Most students attend a branch campus for two years then transfer to the main campus for the last two years of their baccalaureate programs. Our problem: there are no Special Education faculty at the branch campuses but there is a real need to begin instruction about problems of educating the handicapped before the junior year of a 4-year program.

Problem 2:

In 1980, the State Department of Education mandated that all persons who apply for teaching and instructional certificates in any area of education (e.g., counseling, teaching chemistry, supervision, elementary education) must demonstrate ten generic competencies dealing with education of the handicapped. A similar problem existed: insufficient staff at the branch campuses and the main campus to provide even modestly individualized programs or courses of study for such diverse groups.

Problem 3:

There is a need to provide a high quality computer based correspondence course to teachers and parents who want basic information about handicapped children.

335

Our Solution:

In response to the needs sketched above, the University has developed a series of microcomputer modules and an entire three credit course to assist University students, parents, and inservice teachers to obtain basic information about the handicapped.

In addition to the main campus, the University maintains 20 branch campuses which offer basic freshman and sophomore courses. No Special Education faculty are employed at any of the branch campuses. In the past, students in many majors had to wait until their junior year to obtain instruction dealing with education of the handicapped. Now, however, students at any of the campuses can take a three credit course in Special Education at any time. Similarly, students, parents, or teachers in rural areas can take a full course or a set of modules on their own if they have access to a computer.

An Introduction to the Education of the Handicapped is given by microcomputer and is a "stand-alone" course; all instruction is given by the computer through a series of computer modules. The modules are easily transportable to other institutions and use the following computers: Apple (II+, IIc, IIe); TRS-80 (Models III and IV); IBM (PC, PC XT, PCjr).

The course, or a selected set of modules prescribed for the individual student, also prepares students for the special education generic competency examination, which is required University-wide.

The components of the course are: (a) a set of 19 floppy disks (depending upon computer system); (b) a printed manual which provides very brief summaries of each of the lessons on the disks, chapter overviews, references, and related information; (c) an instructional program on the use of the computer, (d) instructor's manual; and, (e) evaluation packet containing quizzes and final examination.

Students are expected to read a chapter in the textbook first, then study the same chapter on the computer. The material is self-instructional and no prior knowledge of computers is necessary. Use of the computer is taught on the first disk. Students are on their own to pursue the materials and may do so at their own pace. However, students should plan to schedule 3 to 5 hours per week computer time.

Subsequent material is completely self-instructional and self-paced. Each book chapter has a corresponding chapter which is programmed onto one to three disks. Each disk takes 30 to 60 minutes to complete, and the estimated instruction time spent on the computer equals roughly 37½ clock hours, the same amount of time as is required for a conventional three credit course. Because the program is self-paced, some students may complete the lessons quickly, where others may work at a slower pace and repeat the lessons as often as they wish.

The course has been in use at Penn State for 2 years; approximately 300 students have completed the course. The entire program is available from Penn State's Department of Audio-Visual Services. Several universities and school systems in the US and Canada have obtained the material for use within their own institutions.

GPC4/P6

SOME USES OF A COMPUTER IN TEACHING, TRAINING, AND TESTING: STUDENT/LEARNER SELF-ASSESSMENT RESPONDING

by

Darwin P. Hunt

New Mexico State University

SOME USES OF A COMPUTER IN TEACHING, TRAINING, AND TESTING

Student/Learner Self-Assessment Responding

Darwin P. Hunt
Experimental Training Center
Department of Psychology
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10 December 1984

> "The proud man...is an extreme in respect of the greatness of his claims, but a mean in respect of the rightness of them; for he claims what is in accordance with his merits, while others go to excess or fall short."
>
> "...he who thinks himself worthy of great things, being unworthy of them is vain."
>
> Aristotle, 4th century B.C.

ABSTRACT

When considering computers as a machine component in teaching, training and testing it is useful to employ systems theory as a conceptual framework. Skinner's proposal that the label, 'computer,' is inaccurate and counterproductive when used to refer to a machine being used for teaching is discussed. An alternative label, 'teaching machine,' has the disadvantage of being associated with the past failure of "teaching machines" to live up to their expectations. Three practical applications based upon our own research concerning the human "self-assessment" process are discussed. They are (a) self-assessment multiple choice tests, (b) self-assessment computer aided testing and (c) self-assessment computer aided instruction and review. The underlying notion is that the day-to-day behavior of people in home, work and leisure situations importantly depends on the ability of a person to assess the correctness of their own responses as well as on the knowledge and skill which they possess. Thus, learning might better be considered a change in a person from being unsure-and-wrong to being sure-and-correct; it is insufficient to consider the learning objective simply to make correct responses.

INTRODUCTION

My explicit interest in trying to solve some problems of teaching was precipitated by my own experience when I first started teaching in 1962. For eleven years prior to that I had been employed as a Research Psychologist by the U.S. Air Force at their Aerospace Medical Research Laboratories at Wright-Patterson Air Force Base in Ohio, where I conducted research and worked as a consultant to design engineers and manufacturers of aerospace systems in the area of, what may be called, Engineering Psychology and also in the multidisciplinary area of Human Factors or Ergonomics (I will use the latter two terms interchangeably).

Ergonomists are essentially behavioral, social, physiological, medical and engineering scientists and professionals who develop knowledge in these areas of human science and apply it to the design, use and maintenance of technological systems and machines. The point of view assumed by most ergonomists and engineering psychologists is that machines may be considered to be extensions of a human's capacities; so that no machine, including a computer, has any reason for existence except for the use by humans (or, in some cases, by animals). Thus, computers are seen as machines which extend a person's abilities to process, manipulate, store and retrieve certain kinds of information.

During this presentation I want to

(a) provide a conceptual framework and a perspective for considering computers in teaching and testing, and

(b) describe three projects in which we have used computers to apply our basic research findings to instruction and testing.

It has been suggested by analyzers of the news that the emphasis during the television coverage of the recent national elections was on style (how the candidates looked, moved, etc.) and on the race-horse aspect (who is ahead, who is moving up, etc.) rather than on the substance and questions which would be more relevant and helpful to the voters' making good decisions. The implication is that the 'device' of television may have diverted people's interest and attention away from more important questions toward less important ones.

In a similar way, emphasizing the computer device, itself, rather than emphasizing the purposes and functions of teaching is likely to produce counterproductive attitudes in teachers, students, administrators, etc. and will direct our attention and energies to the wrong questions. Thus, I suggest that it is essential to construct first a conceptual framework for considering the numerous components which affect teaching effectiveness and costs. Without such a conceptual framework we will wander serendipitously from one component to another: From the teacher component ('The human teacher must be forced or enticed to teach better') to the student ('The student must spend more time on learning basic skills') to machines ('We must use more computers in teaching').

Not only is such component-thinking too simplistic to deal effectively with the complex teaching problems, but also such ineffective efforts are interpreted by many people as indicating that the problems are being solved when, in fact, they are not. Thus, these ineffective efforts are actually counter-productive because they divert money and resources away from more useful projects. The complexities of the problem are suggested by a recent article in the American Psychologist. Follman (1984), in a brief article entitled, "Pedagogue--Paragon and Pariah--20% of the time: Implications for Teacher Merit Pay," cites many studies from 1927 through 1977 conducted in different types of educational institutions which show "...that about 20% of teachers perceived as good, effective and best by some students are perceived as bad, ineffective, and worst by other students" (p. 1069).

As behavioral and educational scientists, the task which is most challenging and demanding of our creative talents is that of formulating insightful questions which are both important and answerable. A conceptual framework is vital to serve as a guide for us to formulate good questions concerning the use of machines, including computers, in teaching. Systems theory (e.g., Miller, 1978), which will be discussed in more detail later, provides such a framework.

I will use as a point of departure a recent article by Skinner (1984) entitled, "The shame of American education." He argues that educators and teachers have not seized the chance to improve teaching because "...the solution conflicts with deeply entrenched views of human behavior, and that these views are too strongly supported by current psychology" (p. 948). I find his comments to be very relevant as well as provocative.

My reading of his article shows that he attributes these conflicts to two general factors: (1) our failure to recognize that machines that teach are teaching machines, and are not computers and (2) a commitment of teachers and of teachers of teachers to humanistic and cognitive psychology.

What Do You Call Machines That Teach?

It is important to select an appropriate label because it

a. helps to construct the conceptual framework within which the computer is considered in teaching and testing,

b. helps to determine the attitudes and dispositions to respond in particular ways of the human teachers, and

c. affects the kinds of research and application questions which are formulated.

The label, "computer," tends to focus the attention on the machine rather than upon the purposes for which the machine is being used. Skinner (1984) has suggested that a more satisfactory and more accurate label, is "teaching machine." Skinner makes the point by proposing,

> Computers are now badly misnamed. They were designed to compute, but they are not computing when they are processing words, or displaying PacMan, or aiding instruction.... Instruction may be 'computer aided,' and all good instruction must be 'interactive,' but machines that teach are teaching machines (p. 948).

The concept that the modern teaching machine simply uses computers for the storage and control of information is shared by most learning psychologists. This may be due to the fact that the idea that machines could be used to teach was introduced in psychology in 1926, more than 50 years ago, by E.L. Pressey of Ohio State University. He developed a machine to automatically administer tests and "...made the perceptive observation that the machine could teach as well as test..." (Adams, 1980, p. 194).

A colleague (Dubois, 1984) suggested to me that the label, "teaching machine", also should be disqualified. In the 1960s, the unkept promises and failures to live up to the heavily advertised advantages of teaching machines produced a backlash and rejection of them. Thus, the label "teaching machine" may have associated with it some residual feelings of past failure and rejection.

Perhaps this is a good place to define teaching and training as the management of a learning situation aimed at the attainment of particular knowledge, skills, attitudes and performance. "Learning" may be defined here as a relatively permanent change in the behavioral potential of a person which accompanies practice. Sometimes the learning objectives may not be very well specified, but that is another topic. A "systems approach" (or general systems theory) helps to maintain one's focus on the purpose of teaching and education and helps to maintain an appropriate perspective for considering teaching machines and computers--or whatever we decide to label these machines.

A Systems Approach to Teaching

During the 1950s there emerged in many military, industrial and academic settings an increasing recognition of the importance of what may be called a "systems approach." One central idea of the systems approach, which started in engineering many years before, is that two or more components interact and communicate with each other in order to attain a common purpose. This kind of approach was being employed by ergonomics scientists to conceptualize the human as a component which interacts with machines (and other people) to attain a common purpose.

Over the past several decades general systems theory has undergone considerable development. The most elaborate and recent application of systems theory to the human being is probably contained in J. G. Miller's "Living Systems" (1978).

However, the behavioral, educational and social sciences, in contrast to the medical and biological sciences, have been slow in adopting the systems concepts and incorporating them as tools for advancing their scientific and professional condition. For example, only in the last several years has there been any substantive mention of general systems theory in textbooks in introductory psychology or in any development of behavioral theories (McConnell, 1983). A representation of a systems approach for teaching and some of the components involved are shown in Figure 1.

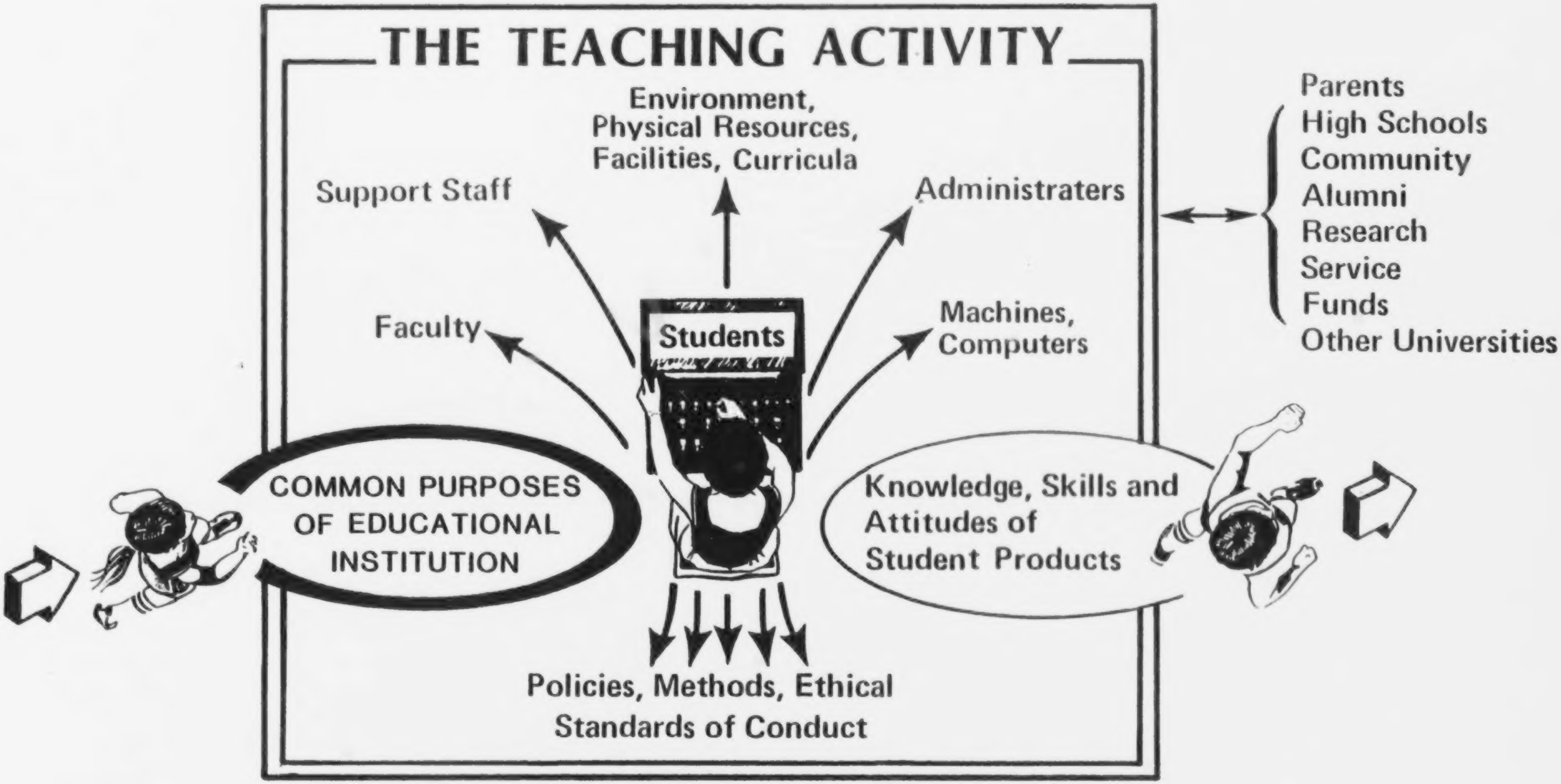
THE TEACHING ACTIVITY
Environment,
Physical Resources,
Facilities, Curricula
Support Staff
Administraters
Faculty
Students
Machines,
Computers
COMMON PURPOSES
OF EDUCATIONAL
INSTITUTION
Knowledge, Skills and
Attitudes of
Student Products
Policies, Methods, Ethical
Standards of Conduct
Parents
High Schools
Community
Alumni
Research
Service
Funds
Other Universities

Figure 1. A conceptual framework of the teaching activity in a university as a system of interacting components, all of them having a common purpose.

I have discussed systems theory in as much detail as I have because it provides a conceptual framework for considering computers in teaching, training and testing. Specifically, computers are considered to be a machine component in a system which consists of other components such as the student/learner, the textbook, the human teacher/trainer, the teaching administrators, the policies, rules and curricula, the ethical standards of behavior which prevail, the environmental factors such as temperature, humidity, noise, and the design of the learning-place equipment such as the desk, seat, informational displays, controller or marking devices and communication modes. For example, there are at least five kinds of devices (light pen, joystick, mouse, trackball and touchpanel) other than the cursor keys on a keyboard which are better for certain purposes (Weissman, 1984) to move a cursor or to mark an area on a monitor screen than are the cursor keys on a computer keyboard (the ones with arrows marked on them).

All of these components combined have a common purpose of the student learning some specified material, e.g., for the student to learn to solve specified problems, to understand some concept or to perform some specified job. In general, the purpose of such a learning and teaching system is to impart some specified knowledge or skills to one or more student learners. Or perhaps, I should say that we should design the teaching system so that it manages the learning circumstances so that the learner's performance potential is altered to be in accordance with the learning objectives.

Consider the first course which I taught in 1962--the statistics course. I delivered well-organized, substantive, interesting lectures for the purpose of the students learning the material from these lectures, the textbook, a workbook, each other, etc. To my great disappointment, the students' performance on the tests were very poor.

An analysis of this teaching problem as a closed loop system led me to the conclusion that one problem was that my interpretation of my observations of the students' behavior, their facial expressions, etc. was inaccurate. Often I believed that they were understanding the lecture material when, in fact, they were not. So an improvement in the accuracy (or validity) of the feedback information to me, the lecturer, should improve the effectiveness of the instruction.

STUDENT SELF-ASSESSMENT:
ASSESSING THE CORRECTNESS OF ONE'S OWN RESPONSES

Each classroom student was given a hand-held button, which he/she was told to press when they were not understanding the lecture. These buttons were connected by wires to a meter mounted on my lecture podium which displayed the percentage of students who were pressing their buttons at any moment in time. When the needle on the meter reached too high of a percentage, then I would stop and try to remedy the apparent misunderstanding. It should be noted that the students had to make an assessment of whether they understood or did not understand the lecture in order for them to decide whether to press or not to press the button.

A consideration of the ability of people to make these kinds of self-assessments led me into a rather extensive program of research and thought concerning the human processes which might underlie this activity and to consider the practical implications of these self-assessment responses. For one thing, my research indicates that simply requiring a learner to indicate "how sure" he/she is of the correctness of each response which is made may speed up learning (Hunt, 1982). More generally and more importantly, the research suggests that the behavior of a person in day-to-day life in homes, work, professions, sciences, sports and leisure, depends on both

a. the knowledge, skills (and attitudes) which a person has acquired from learning and experience, and

b. the ability of a person to assess accurately whether particular knowledge and skills are possessed and whether responses are correct.

Considerable research in the behavioral and educational sciences for a hundred years or so has been directed toward the identification of factors which may help to improve the ability of our educational and training institutions to impart knowledge and skills. However, little systematic or experimental attention has been devoted to what may be called "human self-assessment responding" which is the ability of people to assess the correctness of responses or actions which they are anticipating making--or--which they have already made but not yet received feedback concerning their correctness. Learning might better be thought of as a change in a person's behavior from making Unsure-and-Wrong responses to Sure-and-Correct responses. It is not sufficient, I think, to consider the learning objective simply to make correct responses.

The study of the human self-assessment responding has led me to use machines not only to conduct research, but also to apply some of my research findings. Grants from the U.S. Army Research Institute for the Behavioral and Social Sciences over the past 7-8 years have allowed me to conduct basic research (Hunt, 1984) and to develop many projects, three of which I will discuss today. They are

1. Self-Assessment Multiple Choice Tests
2. Self-Assessment Computer Aided Testing (SACAT)
3. Self-Assessment Computer Aided Review and Instruction (SACAR)

Self-Assessment Multiple Choice Test

This is a pencil-and-paper multiple choice test (see Appendix A) which requires the test taker to mark an answer and also mark "how sure" he is of the correctness of the answer. These answer sheets can be taken to the counter in the NMSU Computer Center where the Answer Sheets are read using the Optic Scanner and scored, by a computer program installed at the Computer Center.

The tests are scored to provide both the conventional percentage correct and a "Self-Assessment Score." The number of points gained or lost on an item depends on whether the answer is correct and, logarithmically, on the level of sureness indicated by the students, as shown below.

	Not Sure	x	x	x	Sure
Correct	+1.0	+2.7	+3.7	+4.5	+5.0
Wrong	+0.5	-0.4	-1.6	-3.2	-6.0

Print-outs (which can be used for the purposes shown) are provided to the instructor as follows:

a. Student Listing giving only Social Security Numbers with no names (For posting to provide feedback information to the students)

b. Frequency Distributions for Percentage Correct and for SA Scores (For posting to help students to interpret their scores and letter grades)

c. Instructor Listing giving students' names as well as Social Security Numbers

d. Item-by-Item Information giving the percentage of students who were Sure-and-Correct, the percentage of students who were Sure-but-Wrong, etc. (To help the instructor detect misinformation, evaluate the teaching effectiveness, identify instructional problems, etc. For example, if a particular test item has an unusually high percentage of Sure-but-Wrong answers then the students may be misinformed rather than merely uninformed; and the teaching methods appropriate for remedying misinformed students may be different than the typical methods designed for teaching the uninformed.)

e. Student Answer Listing of all answers given by all students (To help resolve any questions concerning what answers and self-assessments students gave on the test).

I have employed the knowledge in ergonomics/human factors and engineering psychology in designing the print-outs for the students and instructor.

Self-Assessment Computer Aided Testing (SACAT)

We are just beginning to work on two approaches using self-assessment in a testing situation. One approach is simply computerizing the paper-and-pencil multiple choice test so that students can take the test directly on a computer which (a) provides more rapid feedback to the students concerning their test scores, (b) allows a greater flexibility for the students as to the time when they take the test and (c) provides for the possibility of incorporating the self-assessment methods into other kinds of computerized testing, e.g., randomly selecting from populations of questions.

The second kind of Self-Assessment Computer Aided Testing method is focused on two aims which are (a) using the self-assessments, along with the correctness of the answer, to detect and identify specific test performance deficiencies and (b) taking advantage of the testing session to serve also as a learning session. The general notion is to consider a person as a "system" consisting of a number of components and processes (Miller, 1978) which interact to produce the individual's performance. The testing strategy is to begin questions, within some topic, at a general level and present questions with increasing specificity aimed at identifying the specific component or process which is responsible for the deficiencies relative to the broad topic or job being tested. The approach is to develop an array of different kinds of questions from which one or more would be presented contingent upon both the self-assessment response and the correctness of the answer. The kinds of questions represent different levels or hierarchies of knowledge of skills which, all combined, are required to perform a specified task or job. Simultaneously an attempt is being made to provide a learning situation to remedy the identified deficiency.

A Self-Assessment Computer Aided Review (and instruction) Program (SACAR)

This approach to teaching machines incorporates my belief (based upon my own and others research findings and thought) that the behavior of people in everyday life importantly depends upon their self-assessments. The human self-assessment process has been not only the focus of my research, but also the focus of my attempts to use computers in teaching training. Because the usual computer keyboard is not suitable for use as a teaching machine by most people, I have designed a student response keyboard specifically for SACAR (See Figure 2), incorporating ergonomics principles of design for the human user.

The keyboard provides for the student to enter their identification number, choose from a menu the specific material which they wish to review or learn, select an answer to each item when it is presented and indicate on a 5-point scale "how sure" they are that the selected answer is correct. The leftmost button is labelled "Not Sure" and the rightmost button is labelled "Sure".

Immediately after an answer to a question and an SA response is given, four items of information are presented on the student's visual display:

a. the answer response which the student gave

b. the correct answer

c. the number of points gained or lost on that item

d. the cumulated number of points so far.

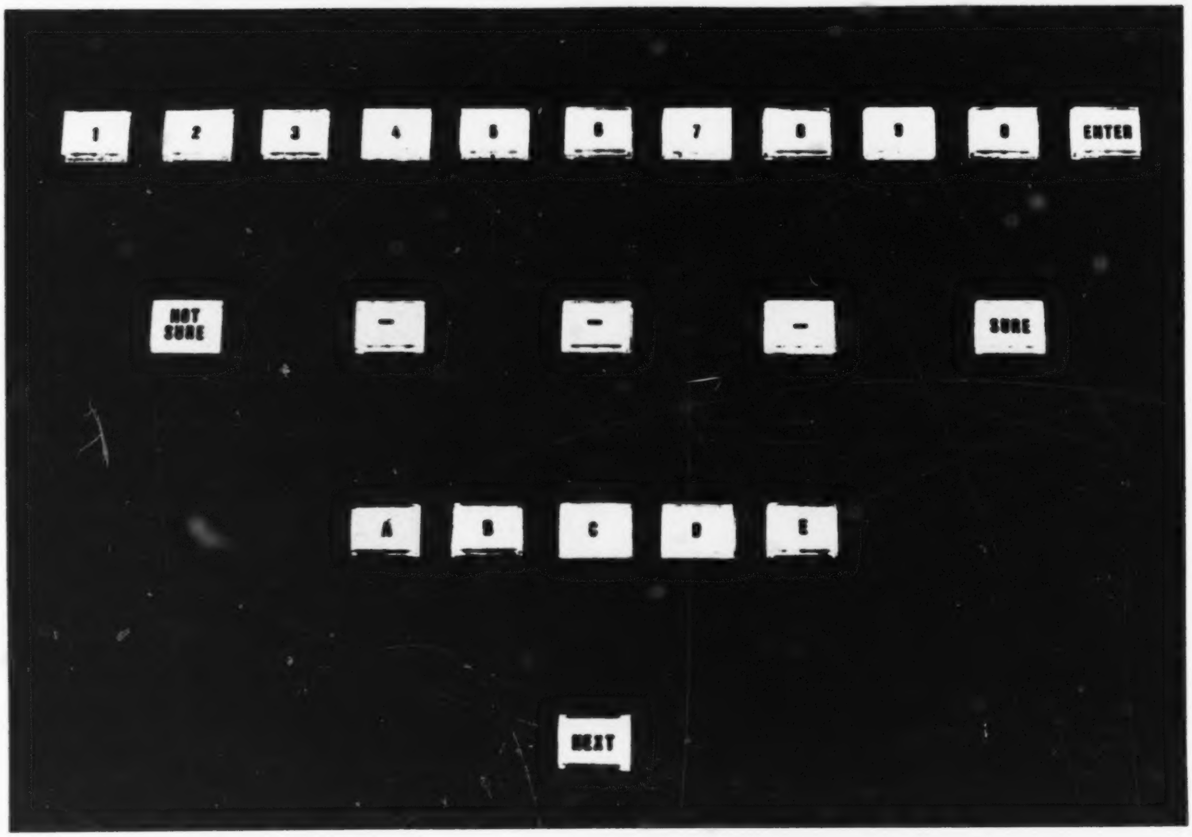

Figure 2. An ergonomically designed keyboard for human learners using the Self-Assessment Computer Aided Review - Instruction (SACAR) machine.

The number of points gained or lost on an item depend on both the correctness of the answer and the accuracy of the self-assessment. The scoring rule for assigning points is the same as is used in the Self-Assessment Multiple Choice Test.

When the student has completed the review of the chosen material, the student is provided information on the visual display concerning (a) the percentage of correct responses to provide feedback to the student concerning the correctness of the answers and (b) an SA score which can range between 0 and 100 to provide feedback to the student concerning the accuracy of their self-assessment responses. This "self-assessment" method could be adopted to almost any computer aided instructional program.

Computer Simulation of Human Self-Assessment Responding

We are also using the computer to construct a simulation of a theoretical model of the human self-assessment process which we have developed. The simulation is called SAM HUMPAT which stands for "self-assessment model of human performance and training." We are committed to what I call a Keplerian approach which emphasizes the incorporation of all that we know about the human perceptual, learning, psychomotor and other

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psychological processes into the simulation. We are not interested in simply constructing a mimic of human self-assessment responding. I call it the Keplerian approach in honor of the inspirational work of Johannes Kepler (e.g., Dreyer, 1953) concerning his laws of planetary motion and it is in contrast to the earlier epicycle models which provide good predictions, but which are based on erroneous concepts of how planets move.

REFERENCES

Adams, J. A. (1980). Learning and memory. Homewood, Ill.: The Dorsey Press.

Dreyer, J. L. E. (1953). A history of astronomy from Thales to Kepler (Second Edition). New York: Dover Publications, Inc.

Dubois, B. L. (1984). Personal communication.

Follman, J. (1984). Pedagogue-paragon and pariah-20% of the time: Implications for teacher merit pay. American Psychologist, 39, 1069-1070.

Hunt, D. P. (1982). Effects of human self-assessment responding on learning. Journal of Applied Psychology, 67, 75-82.

Hunt, D. P. (1984). Human self-assessment and its implications for human training and performance. Summary Report for the U.S. Army Research Institute for the Behavioral and Social Sciences.

McConnell, J. V. (1983). Understanding human behavior: An introduction to psychology (4th Edition). New York: Holt, Rinehart and Winston.

Miller, J. G. (1978). Living systems. New York: McGraw-Hill, Inc.

Skinner, B. F. (1984). The shame of American education. American Psychologist, 39, 947-954.

Weissman, J. (1984). Marking devices for computer-based training. Training Technology Journal, 1, 48-54.

APPENDIX A

NCS Trans-Optic M801-17409-321

MULTIPLE CHOICE SELF-ASSESSMENT ANSWER SHEET

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DIRECTIONS:

1. FOR EACH QUESTION, PLEASE SELECT THE BEST ANSWER AMONG THE GIVEN ALTERNATIVES. USING BLACK LEAD PENCIL ONLY, #2½ OR SOFTER, COMPLETELY BLACKEN IN THE CIRCLE CORRESPONDING TO YOUR SELECTED ANSWER. ONLY ONE ANSWER PER QUESTION ALLOWED.
2. IMMEDIATELY AFTER YOU HAVE MARKED YOUR ANSWER, PLEASE INDICATE HOW SURE YOU ARE THAT YOUR ANSWER IS CORRECT BY BLACKENING IN ONE OF THE FIVE LEVELS WHICH IS MOST REPRESENTATIVE OF YOUR CONFIDENCE IN THE CORRECTNESS OF YOUR ANSWER. ONLY ONE CONFIDENCE RESPONSE IS ALLOWED.
3. THE POINTS YOU RECEIVE ON EACH ITEM ARE BASED ON BOTH THE CORRECTNESS OF THE ANSWER AND THE ACCURACY OF YOUR SELF-ASSESSMENT. INDICATING HOW SURE YOU ARE AS ACCURATELY AS YOU CAN WILL PRODUCE THE HIGHEST SCORE.
4. DO NOT FOLD OR STAPLE THIS SHEET. MAKE NO STRAY MARKS AND ERASE CLEAN ANY MARK YOU WISH TO CHANGE.

EXAMPLE: T F ANSWER HOW SURE ARE YOU?

Ⓐ Ⓑ Ⓒ ● Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ ⓪ ① ② ● ④

YOUR ANSWER IS Ⓓ AND YOU ARE FAIRLY CERTAIN ③ THAT YOUR ANSWER IS CORRECT

WRITE IN SOCIAL SECURITY NUMBER IN SPACE PROVIDED. BLACKEN IN CIRCLE BELOW CORRESPONDING TO NUMBER ENTERED.

⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

DO NOT MARK IN THIS SPACE – FOR COMPUTER CENTER USE ONLY ● ●

NAME ____________________ DATE __________

COURSE TITLE ____________________ INSTRUCTOR __________

	ANSWER	HOW SURE ARE YOU? ALMOST GUESS	PROBABLE GUESS	NEUTRAL	FAIRLY CERTAIN	ALMOST CERTAIN		ANSWER	HOW SURE ARE YOU? ALMOST GUESS	PROBABLE GUESS	NEUTRAL	FAIRLY CERTAIN	ALMOST CERTAIN
	T F							T F					
1	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	16	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
2	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	17	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
3	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	18	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
4	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	19	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
5	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	20	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
6	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	21	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
7	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	22	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
8	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	23	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
9	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	24	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
10	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	25	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
11	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	26	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
12	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	27	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
13	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	28	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
14	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	29	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④
15	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④	30	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ Ⓖ Ⓗ Ⓘ Ⓙ	⓪	①	②	③	④

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DO NOT MARK
OR WRITE
IN THIS SPACE

	ANSWER										HOW SURE ARE YOU?				
	T	F									ALMOST GUESS	PROBABLE GUESS	NEUTRAL	FAIRLY CERTAIN	ALMOST CERTAIN
31	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
32	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
33	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
34	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
35	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
36	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
37	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
38	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
39	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
40	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
41	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
42	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
43	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
44	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
45	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④

	ANSWER										HOW SURE ARE YOU?				
	T	F									ALMOST GUESS	PROBABLE GUESS	NEUTRAL	FAIRLY CERTAIN	ALMOST CERTAIN
46	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
47	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
48	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
49	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
50	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
51	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
52	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
53	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
54	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
55	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
56	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
57	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
58	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
59	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④
60	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓘ	Ⓙ	⓪	①	②	③	④

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A COMPUTER ON EVERY DESK;
IMPLICATIONS FOR THE EDUCATIONAL PROCESS

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A COMPUTER ON EVERY DESK; IMPLICATIONS FOR THE EDUCATIONAL PROCESS

ABSTRACT

The United States Air Force Academy (USAFA) is currently implementing a project to place a microcomputer in every cadet room and put a substantial number of microcomputers in the faculty and staff areas. In addition, the creation of common use areas and laboratories of microcomputers will allow in-class or group utilization of the computers. In all, 3000 microcomputers or more will be brought to the campus to service approximately 4400 cadets and a faculty of about 570. The second phase of the project will link all of these microcomputers and the existing computer resources together with a local area network. We overview this project explaining scope, goals, and overall plan.

The technology which has made this project feasible certainly has some profound educational implications. The general educational issues we discuss are categorized by their impact on students, curriculum, faculty, and support services. Next we present some technical (non-educational) implications. This discussion includes planning, management, hardware and software issues. Although we classify these issues as technical, they have a significant impact on the academic environments and, hence, are just as critical to the university as the educational issues.

Although the project is far from complete, we have learned a number of significant lessons about the full scale introduction of this technology into the academic arena. To conclude, we present our approach to some of the problems and review some of the lessons learned.

1. BACKGROUND

1.1 Introduction

The United States Air Force Academy completed a study of computer support requirements in June 1983. The study concluded that we needed a major expansion of the existing capabilities. The planned expansion includes at least one microcomputer in every cadet dormitory room and a substantial number of microcomputers in the faculty and staff areas. All of these small computers will be linked with the existing large scale computers by a local area computer network. In all, this extremely ambitious project will involve over 3000 microcomputers to serve the approximately 4400 students and 570 faculty.

This much technology will have a major impact on any institution. In this paper we explore some of the issues and share some of our experiences and speculations about the effects of this technology. We begin by discussing the project scope and goals. Given this background, we examine issues that pertain primarily to the education process itself including possible impacts on the students, curriculum and faculty. We next briefly explore some of the more technical issues including the managerial considerations as well as the computer hardware (machines) and software (programs) that support the project. We continue by explaining some of our responses to the problems and conclude with some lessons learned.

1.2 Project Overview

The set of initiatives to meet the future computing needs of the Academy is known collectively as the Microcomputers in the Dorms Project (MID). The MID has three broad goals:

To improve the quality of the USAF Academy graduate,
To enhance cadet educational experiences,
To provide a modern academic environment.

As mentioned, to meet these goals we plan to have microcomputers installed in every dorm room and in many faculty and staff offices and link these facilities and mainframe computers with a network. We will also install computers in laboratories, classrooms and other common use areas. Another important part of the project is to provide a useful environment of software tools for using the computers effectively.

The MID has two distinctly identifiable portions, the microcomputers themselves and the local area network (LAN). While we will deal with both issues in this paper, we view the microcomputers as the quantum leap from where we are now and the network as a lesser multiplier. The big change will be due to the enormously increased availability of computing power and the dispersal of physical control. We feel the network's impact will be one of increased convenience of communication.

For the microcomputers themselves, the envisioned uses may be classified as word processing, educational support, software packages, and program development. The most frequently envisioned use of the computers is word processing. A stand-alone microcomputer has enormous utility for preparing papers, reports and letters. Microcomputers have utility for educational support such as computer assisted instruction (CAI), computer testing, and computer managed instruction (CMI). The CAI use may be somewhat limited to drill and programmed instruction. The more interesting aspects of CAI may require equipment that is too expensive for large scale purchase. The LAN will greatly expand the CAI capabilities.

Word processing and educational programs are special cases of software packages. These prewritten packages support special applications such as spread sheets, inventory, budget or general data base creation. Finally, the more sophisticated users will need support for developing their own programs. This requires a host of software development programs such as editors and high level language compilers. All of these uses are anticipated under the MID.

The local area network has three main features envisioned with elaborations of these features as budget permits. The three categories of service are the ability to access one computer system from another, the ability to transfer files of information between systems, and audio/video channel capability. Remote access allows you to use the micro as a terminal to another larger specialized system. This opens up all applications that are traditionally available only by going to a common central terminal room such as running big programs or packages that are too large for a micro. After you have remote access and file transfer capabilities you then open up a wealth of possible applications, e.g., electronic mail, electronic bulletin boards, centralized storage of information, course material distribution (assignments, lesson plans, special handouts), electronic appointment calendars, etc. The video channels will allow in-room viewing of special lectures, required movie viewing, and ability to view lectures missed due to illness to name a few possibilities.

The project is currently in the stages of specifying the LAN and experimentation with several types of microcomputers. The micros will be specified later this year with initial delivery of half of the final number in June 1986. The other half will be delivered along with the complete network by August 1987. This timeline is dictated by budgetary constraints rather than by anything else in particular.

Since we are just in the early stages of the project, some of the ideas we discuss are speculative. Given the number of problems we have already encountered we suspect that if anything we are understating the difficulties that we will run up against.

2. EDUCATIONAL ISSUES 2.1 Curriculum

There is no question that the proliferation of personal computers in the university environment as well as the elementary and secondary schools will have an ever widening impact on our curriculum. There is no agreement on whether that impact will be positive or negative [CHOR84, OSGO84]. Two of our major concerns as members of a Computer Science Department are: 1) computers driving the curriculum instead of the curriculum being enhanced by the presence of computers, 2) the time demand on students with the increasing requirement for student produced computer products across the curriculum. We are also concerned about the proliferation of bad computer use habits (especially programming techniques) as those without formal computer science education teach the novice users. We also see tremendous potential for enhanced higher education through the proper application of computer power within the curriculum. So, how do we answer the question of where, when, and how to apply computer technology within the curriculum? We certainly don't have all the answers (any of the answers?) but can share our thoughts and planning so far.

We believe early, formal training on the use of the personal computer is important. We have a required computer science course now given to 70% freshman and 30% sophomores. That will probably change to an all freshman course when we pick up the charter of teaching proper use and programming (in Pascal) of the cadet micros. In addition, we are looking at having a required basic skills course given to all students before they start their first semester. This would include basic care and use of the machine, the institutional text editor, and any other "common" software packages. We now have a mandatory typing proficiency test here at the Academy and it is conceivable that testing on a microcomputer would largely replace this. The introductory computer science course teaches Pascal programming skills, structured problem solving, and computer literacy. We are now teaching that course on the Zenith 100 microcomputer with Turbo Pascal. The course is jammed full of information. A curriculum study underway now may expand the material to two required courses.

One advantage of a computer on every desk to the curriculum here at the Academy (largely an Engineering school) is the ability to solve and hopefully understand more complex problems because of the availability of so much computing power. E. W. Dijkstra, noted European computer scientist, has often said that the ability to solve "toy" problems, scaled problems, does not help in solving large (complex) problems. The availability of computer power should allow for the student solution of larger, more complex problems.

There is a large potential gain in the area of computer managed instruction. The availability of electronic products (lesson plans, course handouts, syllabi, instructor schedules, administrative products, computer generated tests, etc.) via the

LAN will benefit their quality, timeliness, and stability. The grading information should be made available to students more quickly to let them evaluate more realistically where they stand in a course. The state of the products that support the curriculum should improve. Achieving this may require far more administrative control than is currently typical.

Computer assisted instruction (CAI) is certainly a hotly debated issue today [CHOR84]. At the Academy, Chemistry, Physics, and foreign languages are currently using CAI. Many other departments are now looking at the possibility of CAI use when we have a micro in every dorm room. The video channels on the local area network have definite potential to support the CAI concepts. Current technology limits this somewhat so that we have not moved much beyond "page turning" at this time. One main concern is the time involved in producing CAI (about 300 hours per hour of instruction). Current CAI authoring packages help some but don't make much of a dent. We have neither the manpower nor the money to produce substantial amounts of CAI. If CAI is to prove cost effective, it may only be for very large, relatively stable courses. We will talk further about this problem under the faculty discussion.

Along with the benefits, we see some potential problems. Even though we have presented the case that engineering students may be able to solve larger problems with all the computer power available it is also possible they will fall into a "plug and chug" mentality with no understanding of the algorithms and concepts behind the computer products. This is an expansion of the same fears we saw with the introduction of programmable calculators. We see a continued inability of students to spell if a word processing "speller" is routinely used. Cheating will be easier to do and harder to detect. Even at our institution with a very strict Honor Code we see the proliferation of the problem. Electronic loss of information will present a new set of problems. We will move from the "dog ate my homework" era to the "computer ate my disk" era. The largest problem to the computer science community is the difficulty in developing and enforcing good programming and use methodology.

2.2 Students

Students will need to be more highly skilled than they are now or at least have a different set of skills. These skills will include typing, detailed level of reasoning, and, of course, computer literacy and use skills. We have found the incoming skills of freshman to be increasingly more diverse. The notion of placement exams, homogeneous sectioning, and validation become more critical. This same problem from computer science will now spill over into the rest of the curriculum with computer skills being necessary in all disciplines. We also see the effect of those students who are poorly trained in computer usage at the high school level which will again affect the whole spectrum of the curriculum. Most students will hold on for dear life to whatever software and hardware products they were originally trained on.

We now see the "terrified" or "non-detail" student in our introductory course. They have (or develop) an irrational fear (hate) of the computer. How will this student fare in a computerized curriculum? We see in this case the computer being a barrier to learning, a frustration, and a time sink. We are not necessarily talking about a "dumber" student, but rather one whose aptitudes lie in a different area that does not involve detailed manipulation.

Word processing should enhance the student's written work and the efficiency in producing that work. We see qualitative improvements in writing as a possibility with appropriate use of easily modifiable outlines and drafts. We have a fear in this area as well as in the other areas of computer usage within the curriculum that the increased expectations of the faculty will exceed the enhancement of capability provided to the student.

Much work is still to be done on the human interface for the student. What are the effects of using ill conceived software packages over a period of time? What is the frustration level when the computer response to an erroneous input is to terminate the session? How do we guarantee good human interfaces across an institution? We feel there must be a standardization of the software interfaces with the students. This requires manpower and money. There will be an information explosion with an addition to the computer power on a campus (especially if you include a local area network as we are planning). The computer allows easy access to this information which contributes to the educational process. Will the explosion be so great and uncontrolled that this advantage goes away?

2.3 Faculty

There will be and is a wide spectrum of acceptance and utilization of the additional computing capabilities among the faculty. At one end we see dictates to "use the computer" without much thought of curriculum impact and on the other extreme we see no desire or knowledge to incorporate the computer. The administration must face up to "selling" good usage on one end and some usage on the other to bring the extremes toward the middle. The ownership issue is very important. The administration must "bring" everybody along starting with the planning phase.

Utilization of faculty time is a key issue. We have already mentioned the high cost of creating CAI (about 300 hours to 1). Will there be "credit" given for creating software for student use? How does the time count toward the "publish-or-perish" game points? The answers can certainly have an impact on faculty size and organization. The computer support environment is going to have to take on a new size and probably a higher position within the organizational structure. Provost for Computing is a new position springing up at many universities. There must be a large effort in the creation and management of any large scale computer project, especially one with the educational implications such as a computer for every student.

Part of that planning must include the training and education of the faculty. This process should not be left to osmosis. The faculty must understand the implied workload when they levy computer requirements on a student. Standards of usage both in consistency and practices must be drilled into the faculty and then enforced. Without this education and enforcement there will be a proliferation of poor practices, especially by the computer semi-literate. Software standards must be created and maintained in such a way to make them enforceable. The computer science department and computer center need to play a key role in this area and the administration must provide the proper mixture of carrots and sticks to cause the necessary standards and practices to happen.

Faculty "survival," like the students', will become more tied to the willingness to incorporate computer technology into the curriculum. What about the "cyber-phobic"? Will fear of computing curtail a faculty member's career on the computerized campus? The hope is that productivity will increase for faculty members but there is concern for the casualties.

2.4 Support Services

There is a whole spectrum of new services that a university must provide if they are to be successful in putting a computer on every desk and having a positive impact on the curriculum, students, and faculty. A big part of these services will include the training for faculty and students. As said before, it is important that this not be left to self-instruction. Bad computer use habits can last a lifetime.

There should be a well coordinated and advertised software library function that has the proper standards to allow software sharing. In addition there must be both software and hardware configuration control to maximize system usage and minimize confusion between departments and different student classes. If a local area network is installed (as we are proposing at USAFA) then there is a large, additional file and mass store management problem.

Security will be a prevalent issue (especially with a local area network). Academic cheating is an unsolved problem with all the capability for masking that cheating with the computer tools available. The privacy of one's own dorm room will add to the cheating problem. If other university services are available on the same network that the students use, the security problem becomes one of nightmare proportion.

If a network is part of the services provided along with a computer on every desk then the network services must be provided. Electronic mail, electronic bulletin boards, electronic filing cabinets, node to node communication, electronic calendar and appointment scheduling, acknowledgement announcements, and large file transfer and storage are some of the proposed user services here at the Academy. We are having a very difficult time sizing the network server computer systems because users cannot project how much and what kind of service they want from a system they have never experienced. We sent an extensive survey to the Academy community. That survey is discussed later in this paper.

3. TECHNICAL ISSUES

To bring a project of this type to fruition without greatly perturbing the academic environment requires significant technical expertise as well as an in depth understanding of the educational process. It should be understood that the project management issues that we will discuss here are just the first step in a three step approach to the technical life cycle. The other two steps, system development and operations, are vitally significant but beyond the scope of this paper. Project management, as we now see it, consists of organizational, management, and planning issues as well as technical issues relating to the hardware and software.

3.1 Organization

It quickly became obvious that the standard laissez-faire approach to changes in our university environment would certainly not suffice for putting a microcomputer in every dormitory room, much less for a local area network to link them together. Every organization which might have by default taken the lead in this type of project (e.g., the computer center, the Computer Science Department, the computer based education working group, etc.) was a bad choice to lead such a project. Generally, these organizations lack one of three credentials: expertise in the area of computer science, expertise in the area of education, or a non-parochial insight into the goals of the university as a whole. Therefore, it was determined very early that a separate organization would be required if the technical environment across the Academy was to be affected. Due to the last of the three credentials noted above, the level of this organization had to be very high in the administration of the university.

Initially, we set up a high level working group to study the issues involved in the proposed project and make some recommendations for milestones and plan of attack. This working group was chaired by the Vice Dean with a number of special interests represented. This group was strictly a coordinating body which levied the actual research and work to other agencies. It was not too long until the working group had outlived its usefulness -- there was an obvious and overwhelming need to have a Special Project Office (SPO) as a single technical and managerial point of contact. The head of this SPO had to be someone who filled all of the criteria noted above. He also had to have sufficient resources available to him to control the timeliness and quality of the decisions he would make about the project. Typically, it appears that the head of such a SPO should be an insider who can devote his/her full energy to the project. This of course is costly because an individual with those credentials will not be sitting idly by but instead will be fully employed in some other important capacity. From this experience it has become clear why some universities have taken the costly step of appointing a Provost for Computing.

3.2 Planning

The reason the project organization is so important to the automation of a campus is because the planning such an organization does affects the academic climate of the university for many years into the future. There are a number of planning issues which a project of this magnitude brings with it. However, the one significant point which must, at least today, be kept in mind while planning for automated campus is that no one has ever done a project of this magnitude before -- there is no reservoir of cohesive experience from which to draw. Therefore, the experiences must be synthesized from fragmented or scaled down experiences in many unrelated environments and fields. The potential cost of bad planning, therefore, is likely to be very high. The following points illustrate some of the aspects of planning that cannot be neglected to include computer technology as a full partner in the curriculum.

The foremost planning consideration is to develop predefined objectives and goals for the campus automation project. It is sometimes alluring to join the move toward the latest and greatest without the difficulty of considering what that means to the curriculum and the university's other goals. We at the Academy almost fell into that trap. It should be noted that it is not a foregone conclusion as some would have us believe that the automation of the campus is appropriate to all institutional objectives.

Certainly, some form of cost benefit analysis is called for. We are estimating that the non-software cost of our project will be in the area of $20 million. This must be combined with the non-tangible costs to determine the actual cost of the project. Additionally, the risk analysis of this sort of project must be considered. Since a project of this magnitude has not been done before and much of the software and hardware is not currently available off the shelf, the risks are higher than for almost any other large scale projects that would be considered in the academic environment. Consequently, definition of the project objectives allows the potential gains to be weighed against the likely costs and risks. The other advantage of having defined objectives rather than allowing the much simpler ad hoc approach is that all other plans, changes, requirement priorities, progress, etc. can be justified or measured by comparison to these goals.

The second major portion of the project planning is requirements definition. There are several important points to remember in the definition of technology requirements in the academic world. The first point is that the user is "clueless" to what he actually wants or needs. (Throughout this, when we speak of the "user" we are speaking of the departments or courses which will require student usage of the technology.) This translates into an inability to remotely, let alone precisely, define the requirements to meet the objectives and goals that have been set forth.

So what is the answer? We did a number of things which are probably a minimum set for determining the requirements accurately. The first step is to bring all of the potential users to a minimum level of understanding of the technology, its potential in academics, and its limitations. The second step is to then ask the users to help brainstorm the possible uses for the technology. We did this in the form of a survey. If a survey is used, it must define the ground rules for the user as far as objectives and goals that have been determined for the project. The survey itself needs to allow the respondent to "crystal ball" his usages or it will be simply a reiteration of current systems. The other side of that, however, is that the survey cannot be totally unstructured or the results will be impossible to interpret and use to define the requirements. Finally the survey must provide some estimates (no matter how shaky) as to the amount of usage by activity that is predicted by the user. (There is certainly another advantage of asking the user what he wants -- so that eventually he can take part of the blame!) The third step in determining requirements, really has two parts: reducing the usage data from the users and determining what other peoples' experiences have been in projects with similar goals and using similar technology. It is at this point that you realize that not only are the users still clueless but they also know just enough to be dangerous. The usage data will require significant massaging by professionals to make any sense at all, and even worse, the data from the different users will be contradictory. The next step, requirements definition from the usage data, will undoubtedly end up as a compromise which will not perfectly suit any one user's needs. Finally you must crank in a factor for the requirements of the future since, as previously mentioned, this is likely to be a long term investment for the university.

The second important point to remember in requirements planning is that you are creating a monster. Once the process noted above has been started, you begin to educate the users to all of the possibilities of the technology. That is, be prepared for the requirements to change as often as you let them. This is of course, not simply a problem of clueless users getting a clue, it also is caused by the political environment of the university, funding, changes in technology, the phases of the moon, etc. It is likely that even the hard and fast objectives of the project will go through some similar modifications.

The third point to mention in the planning for requirements definition was alluded to earlier. If the user is not part of the process, he will typically not be supportive of the project and hence may well cause it to fail. In a high technology project, especially in a typically conservative environment, the element of highest risk is often not the technology itself but the acceptance of the technology by the users. The only way to solve this potential problem is to give the users a sense of ownership by making them perceive that they are involved in the planning.

3.3 Management

Although we will not discuss the later stages of the project life cycle (system development and operations) there is rationale for looking ahead to those stages long enough to highlight the resource management problems we will see. The most striking problem involved in management of widely dispersed microcomputers and a local area network will be the decentralized nature of the technology. In most institutions the control and management of computer resources has traditionally been centralized or at least centralized within departments. This traditional approach to technology management is likely to be a thing of the past. Maintenance, resource accounting, expendable support, security, configuration control (both hardware and software), and operator support are examples of resource management problems which cannot be adequately handled by the traditional approach when microcomputers are spread through out the institution.

3.4 Hardware

A number of issues arise when considering the hardware that will be required to meet the stated requirements and satisfy the institutional goals. As previously noted, one of the first hardware problems will be to specify the systems sufficiently to insure acquisition of the proper equipment. Since this specification is based on the compromised requirements definition there is significant room for inadequate or imprecise system specification. Vendors the world over will always find the lowest common denominator in your specifications and only give you exactly the capability you specified and nothing more. When considering leading edge technology like local area networks, system specification is complicated by lack of experience with the systems, inexact standards and jargon, and a muddy definition of the line between what is available off the shelf and that which requires very expensive R and D efforts. Some schools, like Stanford, have made their microcomputer specifications so loosely defined that a very large number of systems will satisfy them. [OSG084] We have determined that the cost of this type of flexibility in terms of training of multiple systems, maintenance, commonality of labs, etc. is prohibitive. Therefore, our specifications must truly represent our total requirements.

3.5 Software

There is little doubt that software is the most underrated problem in the adoption of the current technology. While hardware has decreased in price by orders of magnitude in the past 20 years, the complexity and cost of software has increased more rapidly. It is now all too easy to determine hardware requirements and develop the appropriate specifications without even considering how the requirements and specifications will affect the software. Computer scientists have now come to the conclusion the exact opposite approach should be taken: the software requirements and specifications should be developed first and then the hardware which best adapts to this software should be selected. We cannot attempt to solve the software problem in this paper but we will list a few of the most difficult software dilemmas.

The high cost of software is a result of many factors. Software development is very labor intensive and currently cannot be effectively automated. Once a program is written, it is virtually never shared or reused; therefore, changes in goals require substantial reinvestment in new software. Software almost never works correctly, and software maintenance is even more costly than software development. The cost to a faculty member in time and energy is ever more profound because of the educational issues that must be wrestled simultaneously with the technical software development issues.

There are, however, some approaches to software which can help to control the costs somewhat. Standards of code development and documentation for in-house software are, perhaps, the first techniques to try. These standards make it possible to maintain and use software packages even after the author has departed the institution. We have seen innumerable examples where perfectly good software had to be scrapped because the only person who understood it was no longer available to keep it running. Some form of sharing and coordination of software is important to keep from reinventing the wheel when a new package is needed within a department. This means a single agency must "store" the software packages and control the configuration of these packages (that is, changes to packages must be made to all users of the same package in order to not reinvent the wheel on maintenance either.) Information about purchase of off the shelf software should also be available from a single reference librarian since many of the departments will be looking for commercial software for similar applications. Finally, education of the administration and staff about software and the potential difficulties is required to hold the software costs in check.

After cost, the second most important software dilemma is frustration. In an educational setting, frustration can represent a significant deterrent to student achievement. Three separate software problems have brought frustration to our students: software which does not work or is not user friendly, software examples which do not follow the standards we require of them, and contradictory user interfaces on software packages. The first problem is obvious, if it does not work or is difficult to use then the student will not bother with it. If we present to the students a two faced approach to software (e.g., you must follow the rules of software creation but I am above the rules), they will quickly question the validity of the rules and also choose to ignore them. Finally, consider the student who has four different courses requiring text edited papers. If all four courses specify different text editors with different embedded commands and different keyboard configurations, the student will probably not do well in any of the courses due to unnecessary confusion they have caused him. Standardizing user interfaces on all packages used within the institution and standardizing the most common software packages (like editors and spreadsheets) among all courses will do much toward solving this last problem.

4.0 THE USAFA APPROACH

One of our most significant steps in the right direction was the recognition of the need for high level planning and involvement. While the project involves other major organizations in the Academy, the Superintendent recognized that academic requirements were the driving factor. Thus most of the required organization is under the Dean of the Faculty. Liaison is maintained with other elements but the driving force, the MID Special Project Officer (SPO), is a faculty member. As was mentioned earlier, anyone qualified to do this job already has a full time job and this is true in our case. Our SPO is the Head of Electrical Engineering and was chosen for his experience in managing other large development projects. Supporting him is a Director of Plans and Programs and a Director for Educational Research working for the Dean. Fortunately these are full time positions. The Director of Plans and Programs is responsible for providing the "big picture" planning for the SPO. The Educational Research Director assists and concentrates on educational uses such as CAI. All these people work closely with the Director of the Educational Computer Center, who is currently responsible for the existing computing resources.

Because of this high level organization, we are able to take a better look at the full impact of the project. For instance, we have addressed some of the problem of faculty education by putting together training courses, both for low level "How to do it" instruction and executive level "What's this going to do to my department" education. We have also published standards for software development to combat the "Fred is the only one who knows how to make this work and he left!" syndrome. We require a certain level of software practices and documentation for any programs that will be configured for student use (enforcement is another matter - probably unsolvable!).

Another top level decision is that there will be a standard software environment. What this means is that there will be institution approved packages and programs for common use. This prevents a student from being forced to learn different word processors for different courses, or different spreadsheets or other packages. The student can then get on with using the computer as a tool and not have the tool get in the way.

We are also taking a complete look at the entire curriculum over this year. A possible part of the outcome may be the creation of another course in basic use and computer skills. This course would quite likely be given to freshman prior to the start of Fall classes so that they could at least use word processing capabilities for paper writing. More sophisticated use would follow in other courses.

Prototyping is an important part of any new large scale project. We used the Honors version of our Introduction to

Computer Science course this fall to try a microcomputer based course. Based on our success we will have all 600 students in the introductory course on the micros this spring. The Mathematics department will also use some micros for some of their courses. Several departments are experimenting with micros for word processing applications.

Finally, we have managed to get a large number of people involved in planning and watching others with similar projects. The experiences at Carnegie-Mellon, Drexel and others give us some confidence that others are proceeding along similar lines (and are encountering similar problems!).

5.0 CONCLUSIONS

All big endeavors have a list of "Things You Have Learned" and "Problems To Watch Out For." We present a list of some of ours in rough order of importance.

(1). Computer Systems Analysts have a saying that goes something like, "It is too expensive to do proper planning. It is more expensive not to." It is true. Don't fall into the trap of the zealots who want to "buy hardware now, plan later." Of course requirements analysis is boring, hard, and a consensus is difficult to achieve. However, you should ask for volunteers of those who want to immediately buy a bunch of hardware and start writing programs and then shoot them!

(2). New management philosophies may be needed. The old idea of the hardware being so expensive that we have to centralize it, while not dead, is seriously ill. Inexpensive hardware makes many of the old ways of controlling ownership obsolete. However, many people overlook the enormous cost of software development and particularly software maintenance. So to save the inexperienced from themselves, to promote sharing of software, and to cut down on student frustration due to inconsistent environments, some form of centralized software control and standardization may be needed. We also require central control for network facilities. How to go about this and maintain requirements for flexibility is unsolved as yet.

(3). Poor computer habits are very hard to break. We want the technology to move us forward rather than set back the field 20 years. Insurance companies offer discounts to teenagers who take a driver's education class rather than learn from their grandmother. Similarly, in computer science we find the students with the most difficulty in our introductory course are those who were self taught or learned bad habits in high school. Plan for proper education of students and faculty.

(4). Information security will become an enormous problem. We see two primary aspects of this, cheating and loss of work. With word processors and floppy disks it becomes a thing of relative ease to plagiarize another's work (with or without their knowledge). We don't know quite how to fully address this problem. The problem of information loss is one that can only be learned by painful experience. You can tell students to back up their work and save copies but until they suffer from it, many won't pay attention. We have seriously considered incorporating a planned "painful lesson" in our introductory course (Attention students! We have just run a magnet past all the machines. Those of you who didn't follow backup procedures will have to type that 1000 pages over!).

(5). We will close with one last shot at the topic of planning. You can't do enough, and while you are at it, think about the future. Don't paint yourself into a technological box. When you establish requirements, ask people to "blue sky." You may not be able to afford some of the grandiose things this time, but try to avoid decisions that preclude flexibility. Finally, realize that planning should be a process with feedback. Try as you will, you can't plan for all problems and potential uses. Many users won't have the foggiest idea what to do with a computer until they get one. Then all sorts of wonderful uses and horrible problems pop up. Formally incorporate this feedback into your plan. It won't always make things go smoothly, but you are miles ahead of poor planning.

REFERENCES

[BRAY 84] Bray, David W. "Using Personal Computers at the College Level", Computer 17,4 (April 1984), 36-45.

[CHOR84] Chorover, Stephan L. "Cautions on Computers in Education", Byte 9,6 (June 1984), 223-226.

[Gale83] Gale, Douglas. "Cornell's Strategy for the Microcomputer Revolution", EDUCOM Bulletin Fall/Winter 1984, 9-11.

[KING83] King, John L. "Centralized Versus Decentralized Computing: Organizational Considerations and Management Options", Computing Surveys 15,4 (Dec 1983) 319-349.

[OSGO84] Osgood, Donna. "A Computer on Every Desk", Byte 9,6 (June 1984), 162-184.

(ZIMM84) Zimmerman, Frederick. "A Z100 on Every Desk: Clarkson College", Sextant March/April 1984, 8-14.

WRITING CAI TUTORIALS WITH PILOT

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WRITING CAI TUTORIALS WITH PILOT

No frustration among those of us in higher education is more ubiquitous than recognizing that our students do not have sufficient command of a subject to study effectively and to capitalize fully on our lectures. Most instructors devise their lectures with care, planning a scrupulously detailed sequence of topics, providing rich details and elaborate examples. However, we recognize that lectures alone do not provide the familiarity, the depth of experience with the topics, or the immersion we seek. By the very nature of the structure of experience in typical classes, students can only be given an acquaintance with the material, and many are left merely with a sense of "covering topics" or "exposure" to ideas. To supplement our instruction, we select textbooks which we hope our students will read and study as a personal challenge to master the material.

Left on their own, however, students frequently read texts unable to synthesize lecture and readings in a significant manner. They become concerned about whether they will be tested on lecture material or readings, and left with what seems to them as no other option, they engage in "psyching out the prof" in selecting the material they study. Even though we hope that the relationship between reading and lecture is clearer than this, students often feel victimized or haunted by bad luck when their guesses are incorrect. As a result, they frequently feel that they are not in control of their academic success and are subjecting themselves to hoop-jumping necessary for the degree they perceive as an entry ticket into a profession.

Many professors who have come to this realization know the powers of computer-mediated instruction, and they have read of or have seen what some people in other departments or institutions are doing with computer assisted instruction. Yet they soon learn that writing computer tutorials for students under most circumstances is more complicated than they may have imagined. First, they often find they must master a computer language such as BASIC. While many academics have developed a knowledge of word processing or even fundamental BASIC, they do not have the time to become expert programmers. They pride themselves in their level of mastery of their discipline, and they fear that their competence as scholars will be threatened if they construct simple or shoddy tutorials for their students. Secondly, use of mainframe operations frequently is taxed, and terminal time remains at such a premium that Computer Science professors look upon others' use of their equipment as meddlesome interference.

With the decrease in the cost of microcomputers, more institutions are developing microcomputer laboratories or general-purpose nests of microcomputers. Fortunately the authoring language, PILOT, is available for most microcomputers, and this language is designed solely for writing drills and tutorial materials for students. By writing these additional study aids, professors from any discipline can provide students with a means of reviewing ideas or applying concepts both from lectures and from readings.

PILOT is probably the least time-consuming language to learn for writing tutorials because it was designed solely for this purpose. Other authoring languages have been developed for microcomputers, but PILOT is one of the earliest such languages and has received considerable field testing. The commands outlined here will be those used in the Apple Computer version, but these are quite similar to those versions designed for other computers. As Figure 1 illustrates, knowledge of no more than a dozen of these commands is all that is required for the framework of most tutorials, although more colorful effects can be generated using still other commands. Compared with other computer languages, PILOT's command structure and sequence are more like English, and each of the commands is descriptive of the function it performs.

Figure 1

Fundamental PILOT Commands

```
*label
T:text
R:remark
AS:accept single character
M:match  (! is 'or') (& is 'and')
TY1:respond to first yes match
TY2:respond to second yes match
JN1:jump to label name on first miss
JN2:jump to label name on second miss
U:use subroutine name (and it will return)
   subroutine has label and has E:as ending
W:3 waits 3 seconds
TS:S2 type specify; 2 is tall
TS:T2 type specify; 2 is thick
TS:I inverse
TS:N is normal
A:accept input from the keyboard
D:N$(20) Dimension numerics
A:$N$ accept a string variable
A:#N accept a numeric variable
T:$N$_,you are nice.  Uses a string variable
   name
```

By merely typing "T," the writer can specify what text is to appear on the screen. "W" indicates that the program is to wait a prescribed number of seconds before continuing, and "M" specifies what constitutes a match when the student enters a response to a question. These commands are perhaps best understood when viewed in the context of an actual sample lesson, so an example is provided (Figure 2).

Figure 2

Sample Program

```
*LABEL
T:WELCOME TO THE TUTORIAL FOR COMPUTER ONE
T:
T:IF YOU HAVE QUESTIONS, PLEASE RAISE THEM IN
   CLASS
R:NEXT IS WAIT
W:3
R:NEXT IS A CLEARING OF THE SCREEN
G:ES
T:GLAD YOU ARE SEEKING EXTRA HELP
W:3
G:ES
D:N$(30)
T:WHAT IS YOUR NAME?
R:NEXT IS AN INPUT TO A VARIABLE.  NOTICE:THE
   SPACE WHEN THE VARIABLE IS USED.
A:$N$
T:$N$ , I'M GLAD YOU HAVE COME FOR HELP
W:2
G:ES
R:NEXT IS A COMPUTE COMMAND TO START A COUNTER.
T:IS TAXITE A MINERAL OR A COMPOUND?
A:
M:MINERAL
CY:N=N+1
TY:GREAT!
TN:SORRY, YOU ARE WRONG.
T:WHAT IS THE SYMBOL FOR TAXITE?
A:
M:C2H3
CY:N=N+1
TY:FANTASTIC!
TN:NO, THAT IS NOT RIGHT.
T:$N$ , YOU GOT #N CORRECT
```

This tutorial begins with a label as indicated by an asterisk; a label allows the program to return to this point from another portion later on, for example, if the student wished to repeat the lesson. All statements which are preceded by an "R" are merely remarks to help document the function of that portion of the program; these statements do not appear in the lesson as it is run. The statements preceded by a "T" constitute the text of the tutorial itself, and "W" specifies the wait period before the program advances. The Statement, "G:ES," is a graphics command which erases the screen so that the next portion of the program can be shown on the display. An "A" commands the program to accept input from the student. The "A: N$(30)" is used to reserve in memory the student's name; in the case of the sample provided, the name can be 30 characters long. Because the name is kept in memory, it can be used at any point in the lesson including the very end where the student's success ratio is reported.

The core of the program, however, is the questions themselves and the means of checking the students' answers. Questions follow a "T" as the usual textual material. An "A" accepts the student's answer, and "M" stipulates what the instructor designates as the correct match to the answer to the question. The "CY: N=N+1" command keeps a running tally of those questions answered correctly; if "yes" a match has occurred, one is added to the value of N, the number correct in this instance. The text that next appears on the screen is dependent upon the accuracy of the student answer. The "TY" indicates what text should appear if "yes" there has been a correct match with the answer specified in the "M." In the example provided, the program displays "Great" if a match has been found and "Sorry, you are wrong" if a match is not found. After this first question is answered, the program simply proceeds to the next question.

While this example is brief and unadorned, it demonstrates the simplicity of the language and its mnemonic qualities. Obviously more complex manipulations are possible, and a number of other commands are available for more elaborate screen designs or use of subroutines. PILOT can be used to develop "branched tutorials" which jump to varied parts of the program depending on the student's success rate or wishes. For example, if a student misses a prescribed number of questions in a row, the program can branch to a loop of remediation materials. Similarly, if a student does not understand certain terminology, the program can offer a glossary of terms and definitions. Additionally, PILOT (at least in the Apple version), includes a graphics editor and a sound editor as well, and these features can be entered into the tutorial.

Relative to other computer languages, PILOT is easier to use for the computer novice, though it retains the potential for expansion as the writer becomes more experienced. An authoring language such as PILOT offers several advantages over other computer languages. It allows entry of text as simply as typing, and the writer must memorize only a small number of commands. It can generate sound or graphics rather easily as compared with the very complex commands that are required by other languages. It is flexible in its testing for correctness of student answers and can accommodate misspellings. Additionally, with the use of something referred to as "wildcards," it can accept alternative answers or lengthy responses from students.

Especially useful also is the integrated quality of the program itself. The program is menu driven, allowing easy access to either the text editor, the sound editor, or the graphics editor. The user is prompted at critical points in editing, and the program contains its own copying function and record-keeping routine as part of its general utilities. While the hardware configurations are yet to be developed and exploited in the field of education, PILOT is designed to be interactive with video devices; as time passes, many exciting possibilities will probably be realized.

As with any computer language or software program, one must also be aware of its disadvantages. PILOT is designed only for writing tutorials, and it does not lend itself to other uses such as numerical analyses or data manipulation. Its simplicity does not lead to broad utility beyond writing tutorials or other similar lessons. Secondly, programs tend to be long and demand considerable computer memory. As computer memory standards increase, this factor is less of a concern, but the nature of

PILOT does not lead to truncated structuring or looping patterns that can be performed by other languages. Additionally, the graphics capabilities of PILOT are limited to rather rudimentary displays, and artistically refined or extremely detailed graphics images are not possible.

The language itself, however, is reasonably simple to learn and can be mastered by anyone willing to devote the time to the program and its accompanying documentation. Becoming proficient at tutorial design may represent a greater challenge. Few members of academe have had this type of training, and structuring appropriate lessons from smaller segments is more complex than may at first appear, particularly if the power of the computer is to be appropriately exploited. If lessons are not developed with care, they will be little more than electric pages of text or aimless querying, and at its worst a poorly designed tutorial might result only in confusing students.

The writer of computer tutorials must plan the structure of the lesson in great detail before entering it into the computer. The major "path" of instruction should be mapped out in flowchart form; remediation loops or enrichment options can then be added later. The core of the lesson must follow sound principles of incremental learning, assuring to the greatest degree possible the student's success at each level and mastery by the conclusion of the lesson. Writing these lessons, however, will force the instructor to be very precise in analyzing and presenting the course material.

As computer assisted instruction grows from its present state of infancy, a number of questions will have to be answered. At this point, we know very little about what types of content can best be taught or reinforced using computers. An initial impression would suggest that factual material requiring multiple rehearsals would be most suitable, but we have yet to face questions of the effects of convenience and novelty. At what point will students find a computer screen less interesting and accommodating than a textbook and a comfortable chair? Further experimentation must also be conducted on styles of content presentation as they influence learning; for example, further research is needed comparing the efficacy of deductive and inductive approaches. We need to become more aware of what is known about superordinate and subordinate structures in the field of prose processing as it may apply to computer assisted tutorials. In short, we will need to see the development of computer assisted instructional psychology which keeps pace with computer hardware development.

These questions will require considerable controlled research, but our own experimentation will also help set the direction of those efforts. At the moment, microcomputers sit awaiting use during parts of the day on many, if not most, campuses, and faculty members from all disciplines can begin exploring new strategies to supplement their instruction with tools presently on the market. PILOT is a viable and powerful language which requires only the willingness to experiment with technology which may be establishing the currents of instruction in higher education for the next several decades. Perhaps we have yet to realize the potential which already exists to involve students in our disciplines in profoundly significant ways.

COMPUTERIZED TESTING FOR BUSINESS STATISTICS: A CASE STUDY

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INTRODUCTION

For some years the Department of Psychology at Texas Tech has had an experimental testing laboratory using a small scale mini-computer, a PDP 11/34 with 256K words of mos memory supporting 28 terminals. Of the 28 terminals only 22 are in the testing laboratory, the remaining being used by instructors and graduate students for research and other analysis. This laboratory was set up initially for the introductory psychology course. During the 1982-83 academic year conversations between Psychology and Business resulted in the addition of the business statistics course to the experiment. The statistics experiment began with the first summer session of 1983 and has been used every semester since that time, with 2,000 students per year. This paper is a summary of our experiences with computerized testing and some recommendations for extensions of the testing program.

THE TESTING SYSTEM

The testing procedure consists of twelve multiple choice examinations of ten questions each. Questions for tests given each individual are selected by a stratified sampling process, with each item having its own pool of questions. This insures that every test is complete, since each strata can be designed to concentrate on a small part of the material. By selecting one question randomly from each strata, every test is essentially unique; that is, if the set of questions for each strata is large enough, the probability of two identical tests being generated is extremely small.

The textbook for this course is the one by Conover and Iman [1]. The examinations do not quite follow the chapter configuration, but come close. The first six examinations are over the first six chapters, respectively. Exam 7 is on the first half of chapter 7, since hypothesis testing seems to be an extremely difficult concept for the students to grasp. Exam 8 covers the last half of chapter 7 and all of chapter 8. Exam 10 covers chapters 10 and 11. Exams 11 and 12 are on chapters 12 and 13, respectively. There is no final comprehensive examination.

For each examination the corresponding textbook material was divided into ten exhaustive strata and a set of 10 to 25 questions were constructed for each stratum. The computer has an upperbound of 25 questions and cur lowerbound is 10. Most of the examination questions were constructed from the exercises in the textbook. Generally, the textbook exercises were used verbatim, but with the numbers changed. Some exercises were modified or shortened slightly to fit the examination structure. The students are given a list of all questions used on each examination at the beginning of the semester.

The basing of examination questions on textbook exercises has several advantages and almost no disadvantages. Among the advantages are the following: 1) The student has a chance to see, read and work the exercises prior to the exam, thereby eliminating the possibility of misunderstanding or misreading the statement of the corresponding question during the examination, 2) The student has a positive motivation to understand how to do each and every exercise that is assigned, quite unlike homework that is turned-in where a large percentage is copied, 3) It is not cheating for the student to seek help in understanding textbook exercises from peers or from instructors -- in fact, this is encouraged. The obvious disadvantage to basing examination questions on the textbook exercises is that the examination is textbook bound and therefore the examination becomes obsolete when the textbook is changed. The obvious solution is to choose the best textbook on the market and stick with it.

SOME BEHAVIORAL ASPECTS

Initially, we had no due dates for the individual examinations. This worked very nicely the first time the computer testing was used, which was during the first summer session with only 200 students, many of whom took examinations ahead of schedule. During the second summer session many students procrastinated, and long lines formed at the terminals during finals week. When this same pattern of procrastination began to appear in the fall semester, we initiated a system of deadline dates for the individual examinations.

Since there are 12 examinations in the course, there is almost one exam per week in a semester. We have three make-up periods, one after exam 5, one after exam 9 and one at the end of the course. In these make up periods the student may make up an exam missed or repeat one in an attempt to raise a low score.

Initially, students were permitted to repeat each examination as often as they wished, with a different test generated at each trial. The theory was that if the student repeated an examination after a period of study, reinforcement would occur.

To avoid student gamesmanship, the grade that counts is the last one. Unfortunately, the reinforcement idea was good in theory but did not work out well in practice. Instead, many students tended to engage in test-roulette; that is, they would repeat each examination over and over without study, hoping that luck would give them a good score eventually. Some students would take a test up to 22 times!

As any student of queueing theory knows, such over-utilization of the service facility quickly produces excessively long lines, and we were no exception. During the 1983 fall semester it was not unusual for students to be in line as much as three hours. As might be expected, the lines always seemed to develop on Sunday night, the due date for all exams. As a result a few reforms in the administration of the examinations were explored for the 1984 spring semester.

First of all, a bonus and a set of penalties were established. A student who took a ten-point test only once received a bonus of one point. Then beginning with the fourth trial, the student was assessed a penalty of a point per trial. The number of repeats dropped to near zero and so did the length of lines. Furthermore, the amount of study prior to the first attempt increased dramatically. Students were quick to realize that they had to score two points higher on the second attempt in order to improve themselves and this was not easy to do.

A second reform was to change the deadline dates from Sunday night to Saturday night. This resulted in the spreading of the last-minute demand to several nights. Students planning to travel over the weekend took their exams on Friday or even Thursday. As a result, the day of heaviest demand became Thursday rather than the deadline day of Saturday.

Both of these administrative changes have resulted in almost no lines during the spring semester and in the following fall semester. However, lines did develop during the make-up periods. The first make-up period had small lines, the second had moderate lines and the third had huge lines. In spite of the fact that students were warned repeatedly not to wait for a make-up period, they did anyway. In fact, many students waited until the make-up period for their first attempt on all the examinations. To reduce this dependence on the make-up periods we are planning a further change: no bonus points will be given for examinations taken during the make-up period and only one attempt per exam will be permitted without penalty. This should discourage students from delaying beyond the initial deadline.

QUALITY CONTROL

The computer testing routine includes an item analysis procedure. After each semester this item analysis gives a discrimination index for each question. This is a point biserial correlation. It measures the relationship between the grade of each student and his or her tendency to choose the correct answer, a measure of the discriminating power of the item. The analysis also gives a difficulty measure with the percentage of students answering the question correctly.

Only after the 1983 fall semester were sufficient data accumulated to obtain meaningful reliability coefficients. In general, the reliability coefficients were very good for the set of questions on the examinations. The few cases of low reliability were due to two causes: (1) typographical error, and (2) fuzzy questions. Although the typographical errors are unfortunate, they can be expected in this huge set of questions (somewhere between 2,000 and 3,000). The important point to be made is that the item analysis procedure was able to detect typographical errors and, as a result, these typographical errors were corrected prior to spring semester.

Fuzzy questions are the result of poor question construction. Such questions were either re-written or eliminated. Thus, the examinations have been greatly improved, and will continue to be improved over time.

SECURITY

To maintain security, the student presents a picture ID to a test monitor, who assigns a workstation to the student. The student logs-on to the terminal takes the test, receives a grade, logs-off, and returns to the monitor to retrieve the ID. The monitor is able, at all times, to display on the monitor terminal a seating chart of all terminals and the test being taken by each student.

EVALUATION OF EXPERIMENTAL RESULTS

Although it was not possible to compare the results of computer-assisted testing via a controlled experiment, one can make certain generalizations based on observations and discussions with students and faculty. These will be grouped according to effects on students, on faculty and on administration.

a. Effects on students

1. More study and better learning.

   In general, students reported that they studied much more. With fixed goals (90% for A, 80% for B, etc.) they strived to achieve.

2. Less stress.

   Because there were no fixed times for the exams, because each exam covers only a small segment of the course and because the students may repeat an exam, the students find they can take the examination when ready under less stress.

3. Constant study.

With an exam almost each week, students tended to keep up with the material as presented in class. Under the old system of one or two midsemester exams plus a final exam, there were only two or three major cram-type study periods. In a course like statistics, students need to keep up or else the lectures become meaningless.

4. No cheating.

In a typical departmental exam with 400 or more students crowded in a room, it is difficult to detect and prevent cheating. In fact, a common complaint of honest students has been the existence of extensive cheating in departmentalized exams.

With randomized computer generated tests, it is essentially impossible for a student to cheat.

5. Better exam questions.

With the use of the item analysis feature, poor questions are eliminated from the test file. Also the type of questions that result in good reliability are noted and these can serve as a guide for future question construction. With better tests, we have more accurate measures of achievement.

6. Immediate reinforcement.

The computer grades each exam immediately and provides diagnostic advice to the student while the topic is fresh in the student's mind.

b. Effects on faculty.

1. Less test preparation.

Obviously, once a pool of questions is generated, there is no need for a rush job of mid-term and final test construction. This frees the faculty to spend more time helping students, preparing lectures and doing research.

2. No cheating concerns.

Cheating by students is always a concern of faculty.

3. Less personalized teaching.

The tests are obviously predetermined. This fixes the syllabus and test questions for each instructor. Thus, the instructor has little or no freedom of choice of material to cover. Also, enrichment materials are not particularly welcome to students if these topics are not covered on the exams. Many instructors do not like such a restriction.

On the other hand this may be the most desirable way to handle core courses, where the content affects future courses. There is a real need for consistency. Secondly, with less need for planning and scheduling, each instructor has more time to be creative in the classroom, to work with students and to do research.

There is nothing to prevent the instructor from basing part of the course grade on class participation, pop quizes, term papers, homework assignments, etc., in addition to the computer tests. In our course the entire course grade was based on the computer tests, and as a result students who thought they could learn through self study stopped attending classes. Class attendance near the end of the course dropped to about 40% despite the best attempts of the instructor to make the classes useful, interesting and informative. Most students who continued to attend classes reported that class attendance had a positive effect on their performance.

c. Effects on administration.

1. Fixed cost factors.

The hardware costs are lower when good management techniques are used to distribute the testing load uniformly over more hours. If student demand is uniform over the hours of open lab time each week, fewer terminals are needed than if all of the student demand occurs at a weekly deadline. With our testing policies we found twenty-two terminals were adequate to service 750 students who averaged 40 minutes per exam. Our testing lab was open 30 hours per week and was utilized at about 50% of capacity overall. With only ten terminals the lab would need to be open more hours per week, and some form of scheduling of students to lab times would need to be initiated. An alternative plan is to print out individual exams, have students work the exam away from the terminal, and then use the terminal only to enter the answers.

This results in less connect time per exam, and therefore fewer terminals required, but has an additional dependence on a mechanical printer which traditionally is more likely to break down. Also, the cost of paper becomes rather significant.

2. Variable cost factors.

By going to a paperless exam procedure approximately one dollar per student was saved in paper and reproduction costs each semester. Furthermore, the exam monitoring was done by student assistants instead of the traditional course instructor, thus downgrading the cost of administering the exams. Hardware maintenance costs offset the savings somewhat.

3. Marginal cost factors.

The marginal cost of adding another course to the system consists only of the cost of staffing the additional lab hours. Since Psychology had the hardware in place for their course, Business merely shared the computer maintenance cost and supplied the student assistants for the additional lab hours.

It appears overall that the computerized testing program has significantly more pros than cons. The final evaluation will come when these students take subsequent courses which use statistics as a prerequisite. Will there be a noticeable gain in statistical knowledge when these students take advanced courses in their junior and senior years? Initial reaction from instructors of courses that use statistics indicates that the general statistical level of the students has gone up.

THE FUTURE TESTING SYSTEM

The highly successful experience which the College of Business has had with computerized testing in the Psychology Department has made clear the value of this type of test delivery. But, the overload which Business has created on the Psychology facilities, the opportunity to expand the testing program to other business courses, and the need to make significant modifications and improvements to the testing system, suggest that the College of Business develop its own hardware and software for computer-based testing. This section describes the proposed design of a College of Business testing center.

Two major modifications are planned for the College of Business testing center, both of which should improve performance and permit significant expansion of the system. The first modification is the hardware configuration. A central minicomputer will be used for the storage of the question bank and for student record keeping. This minicomputer will be netted to a large number of microcomputers. The student logs onto one of the microcomputers. A test for this student is generated on the minicomputer and then the test is downloaded to the microcomputer, along with sufficient software for administering and grading the test. The student takes the test on the microcomputer and receives a grade. The student can even review the test results on the micro. After the student logs-off, the grade along with the student's results are filed on the mini. This downloading of tests to microcomputers will permit almost unlimited numbers of students to take tests simultaneously without interfering with each other on the central computer.

At the present time we are planning the testing center around a VAX 11/780 mini computer with an initial setup of 64 Rainbow microcomputers and a LA 100 printer. The Rainbows will be netted to the VAX. The VAX will download software and test materials to the Rainbows. The students will take the examinations on the Rainbows and upon completion of the test the results will be uploaded to the VAX for subsequent recording and analysis.

A second major modification is in software. Specifically, we plan to incorporate the latest psychometric tool of item response theory (IRT). Item response theory is probably the most significant development in psychometrics in many years. In item response theory examinations are tailored to the ability level of the student. This will most likely reduce the testing time and at the same time make possible item and test statistics which are dependent neither on the characteristics of the examinees nor on the other items in the test. These are invariant. With the item statistics it becomes possible to describe in precise terms the characteristics of the test before the test is administered. This capability allows one to construct a test that is highly efficient in accomplishing the purpose of the test.

Item response theory also provides an extremely powerful tool for special studies such as those conducted by marketing departments of business schools. Because of the resistance of individuals to being quizzed in marketing surveys, an efficient procedure is required. Thus, this testing center could provide a powerful tool for research in many areas of business.

Other modifications that are planned for the College of Business testing center include the review of the last test results by the student and his instructor, something that does not exist at the present time, a process of permitting students to take practice examinations at home or in the dorm, a "desk calculator" whereby a student can make his calculations during the test using the computer, additional use of graphics. It is expected that the testing center will be an extreemly useful center of testing.

CONCLUSION

The Texas Tech experiment with computerized testing has demonstrated that such a test delivery system is both practical and desirable. It is an ideal way for testing in monster-sized classes. It is a convenient way for incorporating the latest of psychometric testing techniques. It is the way most testing at a university probably should be conducted, and thus our experiences at Tesas Tech University, both past and future, will probably be of major significance.

REFERENCES

1. Conover, W. J. and Iman, R. L., Introduction to Modern Business Statistics, John Wiley and Sons, Inc., New York (1983).

2. Lord, F. M., and Novick, M. R., Statistical Theories of Mental Test Scores, Addison-Wesley (1968).

3. Warm, T. A., A Primer of Item Response Theory, National Technical Information Service, U. S. Government Printing Office (1978).

CREATING COST EFFECTIVE CAI FOR THE COLLEGE CLASSROOM: THE ROLE OF TEMPLATED AUTHORING AIDS

by

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CREATING COST EFFECTIVE CAI FOR THE COLLEGE CLASSROOM: THE ROLE OF TEMPLATED AUTHORING AIDS

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The computer revolution is finally infiltrating the college classroom. Every year, more faculty realize they can use computers to do more than teach programming or "computer literacy." They realize they can use computers to supplement regular classroom activities with extended drills, remediation, and self-paced instruction and to deliver whole courses such as introductory foreign language training. Professors of music, biology, chemistry, language training, and mathematics all across the country have helped to lead this revolution that is now attracting professors in the arts and social sciences.

However, we have a long way to go before the benefits of computers in the classroom are thoroughly attained. Three problems stand in the way: (1) purchasing the computers, (2) knowing how to use them best, and (3) reducing production costs. Fortunately, with the technological and theoretical advancements over the past years we have greatly reduced the first two problems. The cost of computers is coming down from around $50,000 per learner station in the 60's to around $3-4,000 now and should decrease further. Developments in higher education and industry are generating a rich groundwork of theory and practical advice about when and how computers should be used.

Although solutions to the problem of production cost have lagged behind the advances in hardware and theory, three different ways of handling the problem have recently emerged. The first solution calls for replacing programming languages with user-friendly production tools geared to non-programmers. These production tools, called authoring aids, range from high-level authoring languages to special-purpose editors that lead to a singular kind of lesson format. Another possibility, very different from the first, would have us avoid most production tools and instead work to improve programming expertise. Those pushing this solution feel that authoring aids impose too many constraints. And finally, we could move the burden of production from faculty to professional design centers. Only in this way, many argue, can the growing body of knowledge about CAI be properly applied. Most faculty do not have the required resources and time to properly undertake a project to design lessons on computers, just as they usually don't have the resources and time to write their own textbooks and films.

While I expect to see advances in all three cost cutting areas, at present I believe that authoring aids have the most potential for getting cost-effective CAI into the classroom. Too few faculty are ready or able to take upon themselves the burden of learning a programming language. On the other hand, we cannot count on commercial or professionally produced courseware (instructional software) because the K-12 market is currently much more attractive and development centers lack funding to write lessons for faculty. In other words, unless the faculty themselves take the initiative, the infiltration of CAI into their classrooms will proceed much too slowly.

With the ease of authoring that new aids appear to afford, faculty have the ability to create such things as individualized CAI lessons, on-line tests, sophisticated drill and practice activities, enrichment exercises for high achieving students, and simple simulations. I have seen these types of courseware developed and used with very positive results.

Because I have high hopes for what authoring aids will help faculty to achieve I have chosen to focus on their use in this paper. I begin by describing the major types of authoring aids and how they can be made easy and effective to use. I then illustrate ways in which faculty can use the aids to get courseware into their classrooms. I conclude with a list of suggestions faculty should consider before authoring computer lessons.

Types of Authoring Aids

Any computer-based software that increases the quality, productivity, or ease of creating instructional materials can be considered an authoring aid. While some computer-based authoring aids exist for creating instruction not delivered by computer, I will exclude them from my discussion. Furthermore, a growing number of aids exist primarily to facilitate design-related activities such as task analysis and the ordering of objectives. One such package is in planning by the Hazeltine Corporation for use on the MicroTICCIT system. Current plans call for design aids to facilitate organizing and retrieving data from task analyses, arranging learning hierarchies, and selecting media to use. But because my focus here is on reducing production costs, I will not deal with design tools in the paper. Nevertheless, I have very high hopes concerning their contribution to faculty who design their own CAI.

In this paper I will focus exclusively on computer authoring aids that directly influence the quality, productivity and ease of producing (i.e. entering into the computer) instruction on computers. And even seen these types of courseware developed and used with very positive results.

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In this paper I will focus exclusively on computer authoring aids that directly influence the quality, productivity and ease of producing (i.e. entering into the computer) instruction on computers. And even more specifically, I will focus on aids that either by careful design or because of built-in limitations template the production process.

Two main types of authoring aids are available: authoring languages and authoring systems.

Authoring Languages. Authoring languages are specialized, high-level computer languages containing commands for simplifying constructing displays, analyzing student responses, and providing simplified branching. Some examples of authoring languages are TUTOR used on PLATO, CAMIL used on McDonnell Douglas's AIS, and SUPERPILOT used on many popular microcomputers. As with programming languages such as BASIC, FORTRAN, and PASCAL, authors program with authoring languages by writing commands in order of execution along with loops and conditionals. However, unlike programming languages, authoring languages have commands to specify, for example, which student answers could be judged equivalent or how to juxtapose text and graphics.

I know very few faculty who by themselves have created CAI with authoring languages. Although usually simpler than programming languages, their use still requires many programming skills. Consequently, most faculty will still require the help of an experienced programmer.

Just as programming languages use different formats and have different capabilities, so do authoring languages. On one end of a continuum, as shown in Figure 1, we have very sophisticated languages like ADAPT Level 3. ADAPT Level 3 (Hazeltine's authoring language for MicroTICCIT) can support development of everything from simple drills to complex, multi-terminal simulations. On the other end of the continuum, we find very simple languages such as PILOT used on the APPLE. Among other things, as we move from the left to the right along the continuum, the languages become more restricted. That is. there are more constraints (i.e., things the languages cannot do), and there are more rigid formats that must be followed (P. Merrill, 1981). But they are easier to use.

<--->
ADAPT 3   PILOT

Figure 2.

Authoring Systems. Authoring systems consist of software programs typically dedicated to a single type of computer. Among other things, these programs provide authors with on-line editors (i.e., special wordprocessing packages) to use in specifying the content and lesson structure.

The MicroTICCIT system helped to pave the way for authoring systems and continues to be a major trend setter. When TICCIT was developed almost 15 ago, it contained one of the first, yet one of the most versatile authoring systems. This system, known as APT (Authoring Procedure for TICCIT), not only cut production costs by eliminating programming, it improved designers' efficiency by providing a theoretically-based design format (Merrill, M. D., Schneider, & Fletcher, 1980). Using APT, faculty can create instruction that is segmented into 3 types of presentation forms: rule statements, examples, and practice questions. Built-in branching specifications allow learners to select these components in any order and keep the author from having to program the branching. To accommodate both fast and slow learners, APT allows faculty to write elaborated and concise variations of rules, include helps during practice, give advice about learning strategies, and systematically vary the difficulty of examples and practice questions.

Several years of intense development by groups around the country demonstrated the effectiveness of APT as an authoring aid. Courses in algebra, English, telecommunications, aircraft flight procedures and many foreign languages have been created by universities, the government, and industry with very efficient use of resources. Because of the success of APT and the inherent appeal of authoring aids that don't require programming, many small authoring systems are now available for microcomputers. These systems are smaller than APT because they tend not to contain features such as built-in course structures, learning strategy advice, data collection procedures, and student performance reports. Table 1 lists some of the new small authoring systems that are available.

Table 1. Sample small authoring systems

Name	Used On	Sold By
AIDS	Apple II	Skillcorp Software, Inc.
The AUTHOR	IBM PC	Phoenix Performance Systems
CAIWARE	TRS-80	Fireside Computing, Inc.
GHOSTWRITER	Apple II	CAURI Interactive Video
IAS	IBM PC	McGraw Hill
PASS	Apple II	Bell & Howell

Authoring systems tend to rely on one of three techniques to simplify the production process: prompts, menus or syntax. Prompts are questions asked by the on-line system which guide authors through the process of specifying text, graphics, branching and answer judging. Menus are lists of options authors can select one at a time. Each option allows authors to give important information about the emerging lesson. Syntax formats use on-line blanks which authors fill in according to a specified format.

Templating the Authoring Aids

In general, authoring languages and systems help reduce production costs by simplifying the demands of entering lessons onto the computer. These reductions in cost can be increased by adding templates to either authoring aid. Templates are content-free lesson structures or shells. They provide the slots and scaffolding into which authors can insert the content with the authoring language or system (and possibily a programming language). The purpose of these templates is to give authors as many ready-made decisions as possible--to simplify as much as possible their task of specifying text, question formats and branching.

There are three types of templates commonly found in authoring languages and systems. The first type, characterized by TICCIT's APT, provides a general format that prescribes the structure and instructional design approach of lessons. When these templates are consistent with instructional theory they not only help reduce production costs, they also help authors design their lessons effectively. They guide authors by dictating how to break the content into presentation forms and how to present them to students. The second type of template is much narrower in scope and specifies the format for screen layouts (i.e, position and amount of text and graphics) and often dictates the sequence and number of different types of screens (e.g., introductions, rule statements, questions, etc.).

While the first type of template allows many things to vary from lesson to lesson such as the number of pages of rule statements, size and position of graphics, scoring, sequencing, and number of practice questions, and overall page layout, the second type contains very rigid slots for frames of specific types of text, graphics or student input. The second type of template further specifies much of the format of each frame. The difference between the two templates is analogous to blueprints for prefabricated houses with different types of customer options. APT is like a set of blueprints that buyers can mix and modify to customize their prefabricated house so that every house may be similar in style but unique in many respects (e.g., size, number of rooms, type of fireplace). Smaller templates are like blueprints with a few superficial options such as color of carpet and type of wallpaper.

The third type of template is a "homemade" master lesson that serves a as model for other lessons. They are created with a programming language, authoring language or authoring system just as any lesson would be. In fact, the template may even be an actual lesson that authors copy to create a new lesson. They replace the content in the copy of the master lesson with the desired content for the new lesson. Authors can also alter, delete, or add commands or specifications in the new lesson so that the final lesson may end up looking very different than the original template.

With the first two types of templates the lesson format and structure are mostly provided by the computer when authors insert content into them. With the third type of template, the format and structure are copied from the master lesson and then can be modified.

Using Templated Aids Effectively

Whether a template will help faculty create cost effective CAI depends on several things. One major condition is the ability of the authors to use the language or system for which the template was created. Another is the match between the constraints of the template and the needs of the author. Frequently, authors need more flexibility than the template permits. This is particularly true of templates that dictate the position and amount of text on each screen. A third factor is the quality of the template itself. Templates based on arbitrary decisions about what lessons should look like are not as likely to help faculty as are templates based on instructional theory. With theory-based templates that meet an author's needs, the authoring process is reduced to three steps: identifying the content, breaking the content into pieces as prescribed by the template and inserting the pieces into their proper places. Unfortunately, most templates are not based on acceptable instructional theories and impose too many arbitrary constraints. At times, even good templates do not fit the authors' situation and would interfere in the design or production process.

The problem of finding an effective template is further complicated by the demands of the host language or system. For example, templates in authoring languages demand too many programming skills for nonprogrammers. Templates in authoring systems may be too simplistic or restricted for programmers.

Fortunately, a new breed of hybrid authoring aids are becoming available that increase the likelihood of being able to use the best template at the right time. One of the best examples of a hybrid is ADAPT, the new authoring package for MicroTICCIT. When TICCIT was first created, authors only had APT, the templated authoring system. Recall that APT required all TICCIT instruction to be neatly organized by objectives into rule statements, examples, and practice and that the learner be allowed to select these pieces in any order. While a lot of excellent, cost-effective instruction was created with this templated system, authors soon found that for certain kinds of instruction it was too restrictive. TICCIT developers at Hazeltine responded by providing a very flexible, non-templated authoring language called TAL. Now authors had the freedom to create many varieties of instruction. But a new problem arose. TAL required programming skills, as do all other high-level languages.

ADAPT, still under development, combines the initial templated system with the versatile authoring language into a multilevel environment (Mudrick, 1984). Level 1 consists of simple prompts and menus for first-time users and for the development of straightforward courseware. As their CAI authoring ability increases, authors can move to higher levels. Level 2 contains more complete menus of available options. Level 3 is the authoring language. Apart from the levels in authoring format or tools, authors can decide what underlying template, if any, to use. This means that an author moderately skilled in programming could choose to create a lesson using the menu-driven system with the rule-example-practice template. An advanced programmer might choose the authoring language with no template. In fact, when the moderately skilled author is ready to move from menus to commands, the lessons created at the one level can be moved up to the higher level without any loss or duplication of work. In a similar manner, authors can use different tools as they improve their ability to write quality lessons. Initially most authors would want to rely heavily on the templates. In time, as their skills improved, they could gradually move away from the templates to write customized lessons. In fact, a lesson created with a template can be easily modified so that any or all parts no longer adhere to the template's formats.

Why Templated Aids

Creating good CAI is difficult; it takes time and careful planning. Nevertheless, I believe there are faculty who can and ought to become involved. I disagree with some of my colleagues who suggest that creating a lesson on computers is like creating a textbook and that faculty don't have the time, skills, or resources to undertake such a project. On the contrary, I suggest that with proper use of templated authoring tools, the size of the task can be reduced to manageable levels. Nearly all aids will reduce the burden of inputting the lesson on the computer. Aids such as ADAPT will also reduce the burden of writing the initial lesson.

I have seen numerous faculty become successful authors either by themselves or teamed with an instructional designer or programmer. One professor I know spent 3-4 hours a week for several months creating German drills on the APPLE computer. He knew little about computers or instructional design. But with a little help from a student consultant he created a simple template using PILOT and used it to create several cost effective lessons. His students can now use the lesson to drill vocabulary words on their own.

Faculty at Brigham Young University, Northern Virginia Community College and Phoenix Community College have efficiently created lessons on foreign language training, basic algebra, writing, and numerous other areas on TICCIT using APT and ADAPT.

PLATO contains many hours of instruction developed by faculty in nearly every subject area. Although they created most of this instruction with TUTOR, PLATO's authoring language, some was created using templates. I was involved with several faculty from Indiana, for example, who developed a template for simple simulations or dialogues between library workers and patrons. Using this template we created numerous lessons at very little cost to teach use of the card catalog.

Other faculty at several universities have used a template called the Corrective Feedback Paradigm (CFP) to teach paired associates (Siegel and Misselt, 1984). I have seen it used to teach the bones of the body and foreign language vocabulary words. Even though use of the CFP results in very sophisticated drills with complex scoring, sequencing, and repetition of missed questions, all the author has to do to create a drill is type in the list of paired associates.

Research evidence illustrates the effectiveness of authoring aids. By observing 143 production groups, over an extended period, Avner, Smith and Tenczar (1984) found that use of authoring aids helped to predict productivity:

> Software production tools showed good results both in original and export settings though documentation inadequacies frequently decreased effectiveness in export settings. Software production tools ranged in sophistication from templates (sometimes simply a CBI lesson that was revised for each new application) to complete CBI languages and authoring environments. (p.88)

But authoring aids are not without problems. I have already mentioned the usual loss of flexibility. In addition, authoring aids tend to preclude creating instruction that can be moved to different types of computers. This means instruction produced on PLATO cannot currently be run on an APPLE and vice versa.

Another disadvantage of authoring aids, except for full-range software like ADAPT, is that they do not allow room for growth. Many authoring languages and their templates are too complex for non-programmers. However, many authoring system and their templates are too simple for programmers. This means non-programmers who become programmers most often learn how to use a templated authoring aid only to put it aside after they have acquired programming skills. At first, prompts, menus, restricted authoring languages, and templates cut costs by helping novices get started and by taking care of a lot of the work to make a given type of lesson. In time, however, as the novice evolves into an expert and the singular lesson format is no longer acceptable, many of the constraints in these tools tend to interfere and slow down the process. ADAPT allows you to "get rid" of prompts and bypass menus.

The Role of Templated Aids

Not all faculty should create CAI. Likewise, not all college-level CAI should be created by faculty. However, many faculty will need to create much of the CAI if computers are going to be properly used in higher education to support on-going instruction. And finally, the professors that do undertake a project to develop instruction on computers ought to carefully consider how templated authoring aids can help them. The following list of suggestions about the role of authoring aids reflect the kinds of things to think about.

1. Aids are secondary to hardware. Because most authoring tools can only be used on a specific computer, faculty considering aids

cannot ignore the importance of hardware. Clearly, deciding to use ADAPT does no good unless the author has access to a MicroTICCIT system because ADAPT only runs on TICCIT and MicroTICCIT. So until a MicroTICCIT system is purchased, aids for available hardware would have to be used. Computer software catalogs, magazines, and user groups will provide most of the information needed about the tools for computers commonly used in higher education.

When hardware isn't already available but will be purchased, the availability of a range of authoring aids, templated and non-templated, should be examined and used to decide which computer to buy.

2. Aids are a means to an end, not the end itself. A child given a hammer will look about for things to pound; a professor with a good templated aid may be tempted to search about for content to be inserted in it. Using the template, like the hammer, becomes the goal. However, such authors must not forget that the primary goal of creating CAI is the improve classroom instruction.

3. Templated aids reduce but do not eliminate production costs. No matter how efficient or easy-to-use a templated production tool may be, it is impossible to avoid all production costs. In fact, many times using a templated aid merely trades one cost for another. For example, courseware templates can save a lot of programming time but may require a lot more time searching for, or creating an acceptable template.

4. Select a template carefully. Authors need to carefully match their CAI and design abilities and ambitions with the available templated authoring languages and systems so that they are not drowning on the one hand or trying to swim in a mud puddle on the other. The value of both types of templates depend on the the author's needs and

project requirements. However, whenever possible, theoretically sound templates should be used. These templates have more probability of leading to successful instruction.

5. Regardless of the aids being used, good lessons require good design. Most authoring aids, especially templated ones, contribute to the design process (i.e., planning) by providing ready-made lesson formats and specifications. However, this does not allow authors to ignore the design phase completely. Correct content must be found and broken into chunks and the importance and sequence of the chunks must be established.

6. Use of aids should be supplemented with expert advice. Few faculty have received explicit training in designing instruction, especially CAI. Through experience they have learned many personal approaches and techniques. These will not often work on computers. To avoid creating instruction that doesn't work, faculty should consult wherever possible with colleagues, computer specialists and instructional designers. In fact, students could even be hired to do the bulk of the production. Just because production tools are available, faculty do not have to do everything themselves. Many projects I have conducted using production aids were greatly enhanced by the involvement of others.

7. With help many aids can and should be customized. Avner, Smith and Tenczar found, for example, that the best lessons were often done with tools that had flexibility (i.e., weak templates), and could be modified to meet a specific situation. I also found this to be true while using the TICCIT authoring language to develop basic skills lessons on the TICCIT computer. I used it to form a template that then

served as the backbone of every lesson.

6. *Look to the future and expect some exciting things to occur.* We are at the frontier of authoring aids. Although much has been done, a lot more is yet to be discovered or developed. New and better templated tools are always on the horizon.

References

Avner, A., Stanley, S., and Tenczar, P. (1984). CBI authoring tools: effects on productivity and quality. *Journal of Computer-Based Instruction*, *11*, (3), 85-89.

Kearsley, G. (1984). Authoring tools, an introduction. *Journal of Computer-Based Instruction*, *11*, (3), 67.

Merrill, M. D., Scheider, & Fletcher, K. (1980). *TICCIT.* Englewood Cliffs, NJ: Educational Technology Publications.

Merrill, P. F. (1981). The case against PILOT: The pros and cons of computer-assisted instruction, computer languages and authoring systems. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, CA.

Mudrick, D. (1984). Adaptive authoring systems for computer-based instruction. *Journal of Computer-Based Instruction*, *11*, (3), 82-84.

Siegel, M. A., & Misselt, A. L. (1984). An adaptive feedback and review paradigm for computer-based drills. *Journal of Educational Psychology*, *76*, 310-317.

Young, J. L. (1984, October). The case for using authoring systems to develop courseware. *Educational Technology*.

UTILIZING THE MICROCOMPUTER AS A TAX PLANNING TOOL IN BUSINESS AND EDUCATION

by

Stan Scott

Peat, Marwick, Mitchell & Co.

Utilizing the Microcomputer as a Tax Planning Tool in Business and Education

by Stan Scott, Senior Manager

Peat, Marwick, Mitchell & Co.

The Peat Marwick tax departments have used computer resources in their work for almost fifteen years, and the microcomputer for the last several years, when the IBM Personal Computer (IBM PC) first became available. This speech discusses the various uses to which these resources have been put, both in business and education, and their impact upon our tax practice.

I. History of computerization in the Peat Marwick tax departments

In early 1970, Peat Marwick began using the General Electric timesharing network. Through the use of timesharing terminals, Peat Marwick personnel had access to hundreds of programs, databases and various information networks, such as U.S. census data.

This network had two principal uses: First, it provided a nationwide electronic mail network, which has been used for such purposes as inter-office communication and up-to-the-minute bulletins on new tax legislation, such as TEFRA in 1982 and the Deficit Reduction Act of 1984. Second, Peat Marwick developed many tax programs for on-line use on the General Electric system, including PLAN1040, a complete individual tax planning system, PLAN1120, a corporate tax planning model, and BANKHOLD, for use with one-bank holding companies.

In late 1981, the Peat Marwick tax departments adopted the IBM PC as their standard microcomputer tool, and by the summer of 1982, each of the approximately 100 operating offices in the United States had at least one IBM PC. These computers are used both on a stand-alone basis, running a wide variety of software, and as communications devices to connect with mainframe computers for use with such applications as tax research and electronic mail.

The advantages of using a microcomputer-based system over our previous timesharing system have been tremendous. First, the cost savings through the elimination of timesharing charges, including both storage costs and access charges incurred by the Firm in using the available programs, have been enormous. Second, because our tax applications are, by and large, spreadsheet based (a point I will discuss more fully later), it has been far faster and easier to write new tax applications than it had been using programming languages such as FORTRAN or COBOL. Spreadsheet-based tax software may also be updated for tax law changes in much less time, and these applications may be easily modified by the operating offices to fit their particular needs. And, finally, there has been an explosion of inexpensive tax software written for the microcomputer, in such areas as estate planning and depreciation.

We have also found that the IBM family of microcomputers has been ideal for our tax department's needs. First, the IBMs have the computing power we need, which includes both faster calculation and disk access time. Second, IBM's presence in the microcomputer world means that there has been a whole host of peripherals available, including add-on memory boards, printers, and color boards and monitors. Third, and most importantly, there has been an enormous amount of software written for the IBM, including both generalized productivity tools, such as spreadsheets and word processors, and specialized tax applications.

The administration of microcomputer activities in each operating office has been handled as follows. Each office has a professional designated as a Tax Computer Applications Coordinator (TCAC), who handles such administrative matters as disseminating information received on new programs and techniques from Executive Office in New York, and a Tax Computer Specialist (TCS), who is perceived as a focal point for microcomputer expertise in the office. Each TCS receives a week of intensive training on microcomputer topics, which is discussed later. For the last two days of this training, the TCSs are joined by the TCACs for discussions of administrative matters as well as current developments in the microcomputer area.

II. Use of the microcomputer in the Peat Marwick tax departments

The use of the microcomputer in Peat Marwick tax departments has focused on four areas: tax calculations, planning models, research tools, and education. Because the calculation of tax liability for individuals, corporations, and other taxable entities is frequently an involved, time-consuming process, we use a wide variety of off-the-shelf tax packages as well as software we have developed ourselves.

As an example of outside software in use by Peat Marwick, there are several comprehensive depreciation packages available on the market today, allowing our clients to avoid the high costs of timesharing or manual upkeep of depreciation schedules, especially where different book, state, and federal methods are selected. Another area is that of comprehensive financial planning, which brings together planning techniques in individual income taxation, estate and trust planning, insurance, etc. to set up an overall financial plan for an individual.

Most of Peat Marwick's tax packages have been written for Lotus' 1-2-3 system, and have been rewritten to operate with the Lotus Symphony software. This program allows us to write sophisticated tax packages quickly and efficiently, which may be easily updated for tax law changes as they become applicable. Symphony has allowed us to provide an on-line help feature for our individual and corporate planning models, so that a user manual is available as an integral part of the system. These packages can be modified by users to fit their particular needs, as, for example, where state tax calculations are included in our federal individual tax model. And, finally, these applications provide ideas and programming techniques for our professionals to use in their own applications.

Peat Marwick 1040, our individual tax planning model, was developed almost three years ago. At that time, it was written for the VisiCalc spreadsheet, which at that time was the most powerful spreadsheet available for the IBM PC. Over the past three years, it has been rewritten for Lotus 1-2-3, and, most recently, Lotus' Symphony program, to take advantage of such features as windowing and an on-line help feature.

Peat Marwick 1040 performs all major tax calculations for taxable years 1982 and forward. It can calculate up to five different alternatives simultaneously, permitting the user to investigate the impact of one or more planning alternatives for a particular taxable year, such as income averaging and tax shelter analysis, or to track the tax liability of an individual for up to five consecutive taxable years. In addition, the model can be customized for the user's particular needs, such as state tax calculations, cash flow projections, and other relevant reports.

The following are just a sample of the calculations performed. Peat Marwick 1040 calculates the two-earner married couple deduction, the capital gain exclusion, limitations on such items as investment interest, medical expenses, and charitable contributions, and special taxes, such as the alternative minimum tax, the special averaging tax on lump sum distributions, and self-employment tax.

Output is provided in the form of summary reports, supplemental schedules providing detail for such items as the calculation of the allowable investment interest deduction, and a graphic representation of tax shelter income or loss, taxable income and tax due. These graphic summaries have proven to be highly effective in client presentations, because they provide a quick pictorial summary of a client's income tax situation.

This model may be used in a variety of different ways. It may be used for a taxpayer at several times during the year to calculate his estimated tax liability, to ensure a safe estimate. It is used for year-end planning purposes, to focus on such decisions as whether to take a capital loss in the current year, or to wait until a subsequent year. And, finally, it may be used to check the tax computed independently by an outside tax return processor such as Fast-Tax or Computax.

Peat Marwick 1120, which also operates with Lotus' Symphony program, is similarly designed for corporate tax planning. Like 1040, Peat Marwick 1120 performs all major corporate tax calculations for taxable years 1982 and forward, for up to five alternatives at a time.

For regular corporations, 1120 calculates such items as the following:

- Capital gain net income
- State taxable income
- State income taxes
- Federal and state charitable contribution limitations

- Net operating loss deduction and carryover
- Dividends received deduction
- Federal taxable income and regular income tax
- Alternative tax
- Fiscal year tax computations
- Variable surtax exemptions
- Various credit calculations, limitations, and carryover, including the foreign tax credit, investment tax credit, and research and experimentation credit
- Capital gains preference amount
- Add-on minimum tax

Because Peat Marwick has a substantial client base of financial institutions, including both banks and savings and loans, Peat Marwick 1120 includes comprehensive calculations of bad debt deductions and bad debt preference amounts. For banks, 1120 calculates the allowable bad debt deduction under both the percentage and experience methods. For savings and loans, 1120 performs four calculations, the percentage and experience methods also applicable to banks, as well as the deduction allowed under the percentage of taxable income method and the experience method for nonqualifying loans. For all entities, 1120 will calculate the minimum or maximum bad debt deduction allowed, and will calculate the bad debt preference amount.

The use of this corporate tax calculation package has all of the advantages outlined with Peat Marwick 1040. The tax professional is encouraged to focus on planning techniques, with less emphasis on the tedium of working through the calculations.

There are a number of other tax calculation packages available to the tax professional. For example, penalty calculations for underpayment of estimated tax by individuals and corporations are performed by two tax planning models, Peat Marwick 2210 and Peat Marwick 2220. These models calculate the underpayment, test the applicability of any or all exceptions to the penalty, and calculate the penalty by applying the appropriate interest rates. Interest calculations on tax due or owing are provided by our TAXINT model, which provides detailed calculations going back through 1975, if desired, applying the applicable interest rate for each period of underpayment, and summarizing all interest due.

At times, it is necessary to perform tax related calculations to determine whether a particular set of tax rules apply, for example, in the area of personal holding companies. Peat Marwick PHCO assists the user in determining whether personal holding company status exists, by calculating ordinary gross income and adjusted gross income and applying the special rules for the determination of rental and royalty income as personal holding company income. If it is then determined that personal holding company status exists, PHCO calculates the undistributed personal holding company income and the tax due.

In addition to tax calculation models, a number of Peat Marwick microcomputer packages assist the user in corporate tax planning, in such areas as inventory analysis, asset purchase vs. lease analysis, and cash flow projections. I will discuss some of these packages briefly.

Peat Marwick LIFO is an inventory model that calculates end-of-year LIFO inventory values for up to thirty years, and computes the LIFO reserve by comparing LIFO to FIFO values. Comprehensive reports are produced, including a summary report showing FIFO and LIFO inventory values and the cumulative LIFO reserve, the composition of LIFO layers using base year costs, and the composition of LIFO layers using indexed costs. As with many of our other planning models, the program produces a graphic representation of the summary report, which may be highly effective in client discussions.

Peat Marwick CASHFLOW is a planning model that produces loan amortization and cashflow reports for tax years 1981 and forward. For loans, this model provides a detailed loan amortization schedule under a variety of assumptions, such as interest only loans, constant principal loans, balloon payments, etc. Comprehensive investment tax credit and depreciation calculations are also produced, including the selection of full or reduced ITC rates under TEFRA, use of ACRS or straight-line depreciation, and the immediate expensing of a portion of the asset cost under I.R.C. Section 179. Similarly, Peat Marwick BUYLEASE performs comprehensive depreciation and loan amortization calculations, to determine whether the purchase or the lease of an asset produces the most favorable results.

When a bank wishes to set up a one-bank holding company, various financial guidelines set out by the Federal Reserve Board, concerning such items as required capital to asset ratios, must be met. Peat Marwick BANKHOLD facilitates this analysis by comparing the impact of a whole range of financial assumptions, including the effects of a beginning asset or capital change, a change in the percentage of bad debt deduction or asset growth, or alternative ownership percentages. The model produces comprehensive reports of projected assets, earnings and capital accounts, the projected cash flow as a result of the proposed acquisition of bank stock, the projected holding company balance sheet as a result of the proposed stock acquisition, and a schedule of unpaid balance on long term. When the optimal results are obtained, these reports are included in the application forms filed with the Federal Reserve Board to obtain permission to set up a one-bank holding company.

This is only a sample of Peat Marwick's microcomputer capabilities in the area of tax compliance and planning. In addition, the microcomputer is used as a tax research tool, primarily with Mead Data Central's LEXIS system. LEXIS provides the tax professional with an on-line research capability, giving him access to current tax cases, regulations, revenue rulings and a whole range of other material.

III. Use of the microcomputer in Peat Marwick educational programs

In addition to the use of the microcomputer in tax compliance, research, and planning, the microcomputer is invaluable in the Peat Marwick professional training courses. In the first 18 months of service with Peat Marwick, every tax professional is expected to complete a self-study course in the use of the microcomputer. This course includes the following topics:

General housekeeping. The professional is trained in the general use of the microcomputer, including basic DOS (Disk Operating System) commands, such as how to copy a file, how to make floppy disk backups, how to use a printer, etc.

Use of Lotus' 1-2-3 and Symphony. Lotus provides us with an all-purpose tool, allowing our professionals to prepare sophisticated spreadsheets with no prior programming experience, communicate via our electronic mail system, and set up client databases. For this reason, the introductory course teaches basic Lotus commands, stressing the spreadsheet, since this is the most frequently used Lotus function.

Peat Marwick tax software. After the professional has mastered the rudiments of the Lotus system, he is trained in the use of Peat Marwick software. Although only a few of the many available packages are covered in this course, the knowledge gained carries over to our other packages, because of their uniform design. So far as possible, the menus, input screens, and report formats are uniform. This lets the professional concentrate on the tax calculations specific to the particular application, and minimizes the time necessary to learn how to use the package.

This introductory course provides the professional with a good working base on which to build in his subsequent use of the computer. Further, in our tax courses, the use of the microcomputer has been integrated wherever possible. For example, in our introductory tax course, which focuses on individual taxation, Peat Marwick 1040 is used with problem material to provide quick numerical calculations. This not only reinforces the knowledge gained in the introductory microcomputer course, but stresses the use of the microcomputer in the context of the client's overall financial and tax status and our importance in helping the client plan properly.

As noted earlier, each Peat Marwick tax department has one or more Tax Computer Specialists, who act as focal points for microcomputer expertise in their respective offices. The TCSs are given a week of intensive training in this area, which covers topics such as the following:

- Symphony training. Two and one-half days are devoted to intensive training on Lotus' Symphony. This course builds on previous knowledge gained of Lotus' 1-2-3, allowing the course to focus on advanced spreadsheet and database techniques, as well as modules on word processing, communications, and graphics.

- Peat Marwick tax software. Recent developments in Peat Marwick tax software are covered, such as enhancements to Peat Marwick 1040 and 1120.

- Spreadsheet techniques. Pointers are given on efficient spreadsheet techniques, such as grouping input items, setting up uniform menus, etc.

- Outside vendors. Current developments in tax return processing, estate planning software, and real estate planning are provided by outside vendors.

- Other topics. Other miscellaneous topics include the use of LEXIS for tax research, data transfers between the Apple Macintosh and the IBM PC, and microcomputer training techniques.

We expect that the knowledge gained in seminars of this sort will be put to use in actual client applications, which will in turn result in even greater use of the microcomputer in the operating offices.

IV. The impact of the microcomputer on Peat Marwick tax professionals

Although the microcomputer has been in use by the Peat Marwick tax departments for only a few years, the impact on our professionals has been profound. We have seen the following trends in this area:

The use of comprehensive tax calculation models have had a number of beneficial influences on the tax professional's attitudes toward performing tax calculations. First, the tedious "number crunching" involved in individual tax planning has been minimized, allowing the professional to focus on planning techniques. Second, the time required to learn the rudiments of taxation has been greatly reduced at the staff level. For example, because Peat Marwick 1040 combines all individual tax calculations on one worksheet, the staff person is immediately aware of the impact of the alternative minimum tax, the investment tax credit limitation, etc. Third, because our models encourage the user to calculate tax liability for a number of consecutive years, the professional is less apt to focus on minimizing the tax liability for a single year, while ignoring the overall impact on the taxpayer.

It is no longer the case that computer expertise is centered in only a few individuals with access to specialized computer programming abilities. The wide variety of microcomputer tools available, most importantly the spreadsheet, bring the power of the microcomputer directly to the professional. This means that the professional can attack a client problem, such as cash flow calculations, directly, instead of being at the mercy of a data processing department.

The microcomputer has also helped the professional to develop greater efficiency in other related areas. For example, with the word processing software now available, a professional can produce a draft report and make corrections in a fraction of the time previously required. The use of microcomputer databases have allowed us to offer clients new services in maintaining their records more efficiently. For example, a client's financial records can be kept on an electronic database so that monthly reports and year-end totals are quickly calculated.

In addition, because the microcomputer explosion is not limited to our practice, but to the business world at large, our clients are growing more and more sophisticated in the use of the computer. This means that we can, in addition to providing the results of our tax calculations, work with the client in developing his own models and planning packages.

More and more, our professionals have recognized that the microcomputer is not only an invaluable tool, but is central to our professional practice. With the pressures of time and the costs of professional time, we can no longer afford to waste professional time in unnecessary manual calculations. For this reason, our professionals are encouraged to use the microcomputer whenever feasible.

V. The future of Peat Marwick's computer capabilities

Not only is the microcomputer central to our tax practice today, but tomorrow's capabilities will extend and broaden our use of the microcomputer. Although it is difficult to predict future developments, we see the following capabilities on the horizon.

The first is in the area of integrated office automation, the so-called local area network (LAN). Such a network allows the microcomputers to run independently of each other, but have the ability to get information from other computers on the network, and use shared printers and disk drives. In addition, data entered on microcomputers can be transferred to dedicated word processing equipment, so that draft reports prepared by professionals can be transmitted to their secretaries for final editing and printing. We are now conducting pilot studies in several operating offices to test the feasibility of such systems.

The second is in the area of expert systems, which are sometimes referred to (incorrectly) as artificial intelligence systems. Such an expert system will contain a massive amount of tax information, including the Internal Revenue Code, regulations, rulings, and court cases, along with rules that make up the system's "inference engine." This information will allow the system to analyze data and make recommendations on the proper tax treatment of a particular situation, or suggest tax planning techniques.

This would take our microcomputer capabilities beyond the areas of tax and financial numerical calculations and tax research, and into decision support systems. At the present time, only pilot studies are feasible, because most current expert systems are simply too large and complex to function on microcomputers. However, as the technology becomes available, with a drop in costs, we will investigate this area further.

Third, we expect that enhanced training techniques will be available through use of the microcomputer. For example, the computer, through the use of questions and answers, might provide specialized tax training for the professional, geared to his particular interests and needs. This will allow our professionals to keep current as to new developments in taxation, as well as broadening their knowledge in the field.

SOME CURRENT AND PROJECTED USES OF COMPUTER TECHNOLOGY IN THE TEACHING OF STATISTICS

by

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SOME CURRENT AND PROJECTED USES OF COMPUTER TECHNOLOGY IN THE TEACHING OF STATISTICS

by

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ABSTRACT

Students in applied statistics courses present a number of instructional challenges: They come from diverse subject matter areas; many are afraid of symbols and formulas; some even have problems dealing with concepts rather than the memorization they often face in other courses. In a day when most routine statistical computations are available with hand-held calculators and more complex ones are available on desktop computers, students need to learn how to select an appropriate technique, and interpret the resulting analysis. To do this, should understand concepts needed to select an appropriate procedure, and they should gain experience in making decisions in contextually comfortable settings.

This paper describes three current and one developing use of computers which respond to some feature of the instructional setting described above. For the purposes of this conference, these uses should be regarded as ways to respond to instructional challenges, not as objects of interest.

1. INTRODUCTION

Did you take an introductory applied statistics course as an elective? Probably not. Applied statistics is a graduation requirement for most of our students, graduate as well as undergraduate. Required courses outside of students' majors have two strikes against them before they start.

This introduction expands on the instructional environment in applied statistics to give the setting for the four illustrations of computer enriched instruction. The illustrations range from fairly mature applications to ones in the initial planning stages; they use computers ranging from mainframe to microcomputers. Because this paper is intended mainly for nonstatisticians, it concentrates on the motivation for the computer usage and on its general form, not particularly on its technical details. Hopefully, this approach will help illustrate kinds of opportunities for using computer technology in instructional situations. The first two illustrations were discussed for statisticians in Southward, Urquhart, and Ortiz (1983).

Students in an introductory statistics course exhibit several forms of heterogeneity which should influence how we teach statistics. They come from a wide variety of disciplines: from accounting to zoology; from agriculture to engineering technology; from computer science to police science. They differ greatly in previous experience: The student who has gathered and tried to understand data has an entirely different perspective from one who has few real world experiences with data. Some, but not all, of this diversity can be removed by creating different sections for students with different backgrounds, but the utility of extensive sectioning is limited by scheduling and funding.

The national media have noted the general decline of ACT scores and similar measures of college preparedness. These declines include mathematics preparedness. These declines have led some institutions, New Mexico State University included, to impose some sort of mathematics proficiency requirement as a prerequisite for entry into courses past a specific level. Remedial courses exist to help the unprepared students meet the requirement. In spite of the requirements and remedial courses, many students still are afraid of symbols, do not understand what a formula tells them, and often cannot see past a particular application to the general concept it is intended to illustrate. Thus diversity in mathematical insight provides another major source of heterogeneity with which we must deal.

The appearance of various comprehensive statistical computing packages has led to a popular, but rarely stated fallacy: If students can learn to use a statistical computing package well, they do not need to take a statistics course. Nothing could be further from the truth. In order to effectively use a statistical computing package, the user must decide which program or procedure in the package fits his/her needs, and then choose appropriate options. In a particular case, there may be 30 to 100 programs or procedures to choose from, and each may have as many as 20 major options. Several of the major statistical computing packages are designed so the user has to employ several different procedures, in an specific order, to accomplish an analysis which is appropriate for a particular situation. Clearly, a user faces tens of thousands of possible configurations of analyses. After a particular analysis is done, what does the stack of computer output, perhaps several inches deep, mean in the context of the original problem? Informed decision making in this computational context requires a good understanding of the theory, **NOT** necessarily the mathematics, behind the various procedures. This presents a real instructional challenge when students arrive with limited overall mathematics preparation, and seemingly more interest in immediate applications than in concepts.

2. COMPUTER GENERATED ASSIGNMENTS

The first illustration of computer usage concerns the assigned lab or homework exercises. One way to partially deal with students' concern about how a topic relates to their discipline is for some of the exercises to have contexts which are specifically associated with their respective disciplines. Further, it would be helpful if each student's data were somehow unique. The latter characteristic raises the level of interaction among students from "What answer did you get?" to "How did you approach that problem?" This shifts discussion among students from numbers to concepts.

Faculty in the Department of Experimental Statistics have developed a computer system for creating such problems, and for preparing personalized assignments for each student. Necessarily, accompanying answer sheets must be produced for the instructor, and for subsequent use by the students. Once problems are developed and the instructor makes decisions about what subject matter areas - students from related majors - get what problems, an assignment can be setup, executed, and sent to a high speed printer in less than ten minutes. The development of individual problems takes from one to several hours, but once done, they can be improved and reused. Students provide a good source of relevant problems and are good critics of the wording of specific questions.

Completed problems are stored in four parallel computer files, one each for the problem text, the specification for the generation of the random data to be embedded in the text, the answer text, and the way to compute the answers to appear in the answer text. All four files are closely linked by how the objects are named in the respective files. The problem text carries substantial identification and keys which characterize several features of the problem, including its subject matter area and its statistical type. With experience, the wording of the stored problems has been improved, partly in response to student criticism.

Another file contains information about a specific class, including a class list which gives each student's name, major, and broad subject matter area. This file also contains information about each assignment which is to be passed out. A class assignment contains header information appropriate for that assignment, and a table which relates the students' subject matter areas and the assignment's problem numbers to the identifiers of stored problems. For example, in assignment four, assignment problem one could be stored problem 72 for all students. Assignment problem two might use stored problems 78, 79 and 102; 78 might be used for social science and business, 79 for agriculture and biology, and 102 for the remaining areas. There could be more assignment problems if appropriate.

When an assignment is run, the controlling computer program requests the class identifier and assignment number. From this it retrieves the class list and the specifications of the assignment. It then loops through the class list placing each student's name in the appropriate place in the assignment header. Using the student's subject matter information, it retrieves the appropriate stored problems, generates that student's random data, embeds the data in the text, and otherwise prepares that student's assignment for printing. After the assignments for all of the students are completed, the accompanying answer sheets are prepared in an analogous manner. Each student's data is generated a second time by resetting the beginning point for the random number generator. Alternatively, the answers can be evaluated at a later time than when the assignments are created. This feature can be useful when new stored problems are being prepared because the answer text and answer generator can be prepared several days later than the problem text and its generating specifications.

This system has been used for several years by several instructors in four classes. We presently are considering expanding its use to another large, multisection class.

In order to effectively use this system, we need to clearly keep the objectives of a stored problem in view, and use it at the appropriate time. Even though each use of a stored problem leads to new data, we still must be careful with problem files which students pass on from one semester to another. This particularly impacts on how answers texts are written. If discussion questions have detailed responses on the answer sheet, some students will give almost that identical answer in subsequent uses of that stored problem. Instead, the answer text can ask questions which will point the student toward the appropriate ideas. We had anticipated that individualized assignments would take longer to grade. Much to our surprise this doesn't seem to be the case.

Is this computer usage limited to statistics? We think not. In principal the ideas advanced here could be adapted to any area which assigns quantitative problems to students. The value of making problem texts and data characteristics which reflect students' disciplinary interests would depend on the subject being taught. The value of student-specific data should extend at least to some courses in accounting, chemistry, physics, engineering, and mathematics. In fact the system we use relies on statistics only in the precoded ways to compute answers.

At present, the system described in this section is implemented on the academic mainframe computer at New Mexico State University. It uses the text editor named PRESS and is implemented in the computer language named APL. Certain details of the system depend heavily on this environment. This system was started with a modest grant from our university for student programming support.

3. DECISION MAKING IN AN ADVANCED REGRESSION COURSE

The second illustration of computer usage was designed to help students learn to make decisions within the context of regression analyses. Some statistical analyses require relatively complex computations. To make such an analysis appropriate for a particular situation, the user must select many specific computational alternatives. A user of this analysis at another institution, and/or at another time probably will not have the same computational alternatives as are available on a particular campus at a particular time.

We have developed a regression analysis package which is instructionally, not production, oriented. It forces the user to make many decisions which might be made for him in more production-oriented environments. Further, so that a student is not overwhelmed by the number of alternatives - many not yet discussed in class - the instructor can release alternatives as students become ready for them. This system has evolved through four distinct editions in response to constructive criticism from students, and in response to changing computing environments.

The system has three distinct parts: preliminaries, analyses, and termination. The preliminaries begin by identifying the student, or other user for subsequent information needs, obtaining information about the user's terminal, and providing an opportunity for information about the interaction. Then the system presents messages from the instructor. Here the instructor may place information about common or individualized data sets, or minor changes in the system. The body of the analysis has two major parts: development and identification of the data set to be analyzed, and the actual analysis. The termination phase deals with one important matter before shutting itself off, namely, printing. Earlier editions of this system were designed for printing terminals; the interaction with the computer would provide the desired results. As printing terminals are slow, and subject to serious maintenance problems, most of them were replaced by video, or TV-like terminals several years ago. In order to execute the system at a video terminal, the entire conversation and results had to be captured, a major change between the third and fourth editions. During the termination phase, the user can choose to have the captured conversation printed at the central computing facility; otherwise it disappears.

This system utilizes menus, questions with yes/no answers, and questions with numeric or literal (character or letter) answers to communicate with the user. The menus can present up to ten alternatives; the user makes a menu selection by entering a number or depressing an associated function key if the terminal being used supports these. Menus are used to present major alternatives. The system obtains specific information by asking specific questions. The mechanism for accepting responses allows the imposition of various conditions on the user's response. For example, if the answer to a particular question needs to be an integer between one and seven, the user's response is checked for this condition; if the input does not meet the conditions, the user is asked to try again. When the computer requests a piece of information, the prompt or requesting message is taken from a file. This system allows the possibility of prompts coming from any of three parallel files. This, in turn, allows the designer to have long, very informative prompts in one file, while very brief, but equivalent prompts exist in another file. A user can change the file providing the prompts at any time by giving certain specific responses to a question. This allows the user to get brief prompts in familiar parts of the system, but more lengthy ones in new parts of the system. Users will encounter this situation because the instructor can prevent any menu entry from appearing until an appropriate time, such as after the topic associated with the menu entry has been discussed. This locking feature has another characteristic: A menu alternative may be prevented from appearing until the user has completed other, possibly prerequisite, menu entries. For example, a user cannot proceed to the analysis menu until a data set has been defined for subsequent use.

The data entry menu allows a user to retrieve his/her own data set previously generated by the system described in the preceding section, to enter data directly, to make a variety of data transformations, to display any currently defined data set, to identify a data set for subsequent analysis, or to proceed to analysis. Two of these options currently invoke other menus to accomplish their tasks.

The data analysis menu presents several preanalysis options for examining a data set or defining an analysis model, an analysis, and several postanalysis alternatives. An alternative for plotting any currently defined aspect of the data set is always available. A user can return to the data entry menu as another alternative which terminates data analysis menu. A user may select any available menu alternative or sequence of alternatives as frequently as desired; this is true for both the data entry and analysis menus, provided the prerequisite conditions have been met.

The system has evolved in response to various student suggestions and criticisms. Other instructors have used this system when they taught the course for which it was designed. All have suggested improvements, but one has been particularly helpful. Even though the system has evolved over nearly

15 years, and has been extensively "student proofed", occasional errors still remain. The language environment in which this application is written, APL, allows sophisticated error trapping. Consequently, an application designer can incorporate processes which allow the application to recover from errors which would cause termination of the system in other language environments. This protects the user from being particularly victimized by the language environment in which the application is developed. The user can even invoke this error recovery process with the word QUIT to escape from a menu alternative which he/she recognizes as inappropriate. The system records all errors which are trapped. The designer can examine these to identify and correct system features which fail under specific conditions.

This fourth edition is implemented on the academic mainframe computer at New Mexico State University. A fifth edition is partially developed. It is designed for use on microcomputers, IBM PC's in particular. Microcomputers provide several advantages over mainframes for this application. They allow much better control of screen displays, and thus a far superior menu driver. Further, the current campus computing environment is being expanded by the addition of a local area network for computer communication. When completed, this will allow network users to access and share files stored on any device accessible, with security, from the network. In particular, the developer can store an accessible version of the system on his microcomputer, and give his students access to it.

4. COMPUTER DRAWN TRANSPARENCIES

The third illustration of computer enhanced instruction concerns the development and use of overhead transparencies. These instructional tools solve some problems, but pose others. Instructors who use an overhead projector often use many handwritten transparencies due to the various "costs" of developing nicer ones. Furthermore, students often feel, legitimately, that instructors go through transparencies too fast. At present, we partially solve this problem by placing copies of handwritten transparencies on reserve in the library. Many students reproduce these, but complain, again legitimately, about the cost. An instructor rarely is willing to invest much more than this in handwritten transparencies.

We have tried to deal with most of these problems by developing appropriate computer software. By interfacing an inexpensive pen plotter with a desktop or microcomputer, the micro can drive the plotter to make transparencies. By implementing appropriate translation tables, the plotter can do special things such as change pen color, make subscripts and superscripts, or draw objects of special meaning in a discipline. Once setup, the micro can have the plotter make a transparency in five to ten minutes. This goes a long way toward solving the problem of making decent transparencies quickly and in a timely manner. It also allows simple editing and re-creation of transparencies which don't accomplish their objective well.

But what about the students? The micro can have the plotter reduce the transparency to half size in both height and width so that four fit on one side of a piece of paper and four more on the other side. Most lectures use no more than eight transparencies; a copy of all eight can be given to each student inexpensively, on a single sheet of paper. A set of transparencies which accompanied the oral presentation of this paper appear after the references as an appendix.

This application has been implemented on an IBM PC with a Hewlett-Packard model 7475A graphics plotter. A microcomputer version of the editor named PRESS,also used for the application discussed in section 2, is used to create texts. This editor has been expanded for the present application by adding commands to translate certain character patterns into parts of formulas and statistical symbols. This application is developed, implemented, and in final testing stages. I anticipate using it this spring term.

This sort of use of microcomputers could become widespread. I know of a faculty member in another department who is using a different kind of computer in similarly to that described here. Currently he is using it more for scientific presentations than for teaching, but his tools would serve teaching equally well. Some microcomputers, such as the Macintosh, have features which are well suited for making some kinds of transparencies. The image of a desired transparency can be created directly on the screen, and then printed. Most copy machines available in universities will make transparencies from a printed original of this sort. Transparencies are being made this way.

5. COMPUTER GRAPHICS FOR STATISTICAL TESTING

The fourth illustration of computers to enhance instruction involves computer graphics; this application is in its development stages. It is mentioned here to emphasize the importance of planning so that the technology will support instruction, not become the object of interest.

The topic of statistical testing seems to be difficult for students to grasp. But grasp it they must; otherwise their use of statistics will remain rote, and will frequently lead to misinterpretations. We are beginning to plan dynamic computer graphic demonstrations as part of an instructional module on statistical testing.

The module has one overall objective: understanding the concept of a statistical test. Mastery of this overall concept requires an understanding of these components: a probability model; null hypotheses; alternate hypotheses; types of errors; impact of the null hypothesis on the probability model; impact of the alternate hypothesis on the probability model; a division of outcomes into two sets (acceptance region, critical region); probability of errors under the null and alternative hypotheses, respectively. All of the components will be discussed in lecture. Once students have begun to grasp the ideas of null and alternate hypotheses, and of types of errors, computer graphics has promise for clarifying the remaining ideas. In particular, the general probability model can be shown one place on the screen, how it becomes specific under the null and alternative hypotheses can be shown elsewhere. Students can be allowed to experiment with the division between the acceptance and critical regions. The appropriate parts of the respective distributions can be shaded, and probabilities of the errors shown in "thermometers". As students move the boundary, the probability "thermometers" will fill or empty. Students can have assignments to get regions with specified characteristics.

An important feature of this planned application will be to allow students to experiment and get nearly instant feedback. Presently such a experiment requires extensive use of tables. The logistics of using tables becomes such a hindrance to many students that the important concepts drown in table usage.

6. CONCLUDING COMMENTS

Does it take much time? Is it worth it? Emphatically YES, to both questions.

The use of computers as a teaching tool adds little, if any, time to the teaching of a course. The time goes into preparation of materials. Before you can begin to use a computing tool, YOU must become familiar with it! How much time this takes will depend on the computing tool you plan to use, and on the support structure you have at your disposal. Even if you are lucky and have support to develop an application, you have to understand the tools well enough to decide how they fit your teaching situation. If a student employee, or a technician is qualified to make the teaching decisions, why are you needed? Presumably, you have the knowledge and experience to know how to approach the subject matter in the context in which it is to be taught. Either you will have to develop the tool yourself, or you will have to direct the development by someone who knows the technology well.

Appropriate technology, appropriately adapted to your context, can greatly improve your communication as a teacher. It may open avenues so you can reach students you previously lost. It may provide totally new ways to explain a topic. You may see the topic in a wholly new way. You can save your successes, improve on your acceptable presentations, and discard your failures. Don't plan to always succeed. If your channels of communication with students are open, you will know when you have succeeded, and when you have failed.

Success will nearly always require planning what you are going to try to achieve. The instructional objectives should remain as the guiding force. For almost all of us, the computer should be viewed as a tool, not as the object of interest.

7. REFERENCES

Southward, G.M., N.S. Urquhart, and M. Ortiz (1983). Computerenriched instruction of intermediate level statistical methods. **PROCEEDINGS of the SECTION ON STATISTICAL EDUCATION, AMERICAN STATISTICAL ASSOCIATION.** 1983. pp 6-9.

8. APPENDIX

See the following three pages for illustrations of transparencies of the sort discussed in section 3. These accompanied the oral presentation.

TEACHING-1

SOME CURRENT AND PROJECTED USES OF COMPUTER TECHNOLOGY IN THE TEACHING OF STATISTICS

by
N. Scott Urquhart
New Mexico State University

OBJECTIVE: Suggest, by illustration, how computers might be used to enhance instruction

CONTEXT: Applied statistics; level: introductory to intermediate

ILLUSTRATIONS:

> Computer generated assignments

> Decision making in regression

> Computer drawn transparencies

> A use for computer graphics

TEACHING-2

INSTRUCTIONAL REALITIES IN TEACHING STATISTICS

STUDENTS DISPLAY *HETEROGENEITY*

- Subject matter areas - majors
- Motivation - relation to major
- Mathematical preparation
  - symbol shock
  - meaning of formulas
- Experience with data

SECTIONING ON MAJOR and/or PREREQUISITES

PROVIDES ONLY A PARTIAL SOLUTION

===> COMPUTERS CAN *INDIVIDUALIZE*

TEACHING-3

COMPUTER GENERATED PROBLEMS

OBJECTIVE: Produce personalized problem sets. Each student's problem set should have:

- UNIQUE DATA
  - changes interaction among students
  - virtually eliminates copying
- CONTENT WHICH REFLECTS STUDENT'S MAJOR
  - equivalent instructional content, regardless of the problem's disciplinary content
  - problems differ only in nouns, adjectives, and data size
- MOTIVATIONAL VALUE
  - increases interest
  - "relevance"
  - unanticipated: student's *pride* in their *own* problems

TEACHING-4

PROBLEM FILES

PROBLEM TEXT
P0215

PROBLEM GENERATOR
PGP0215

ANSWER TEXT
ATP0215

ANSWER GENERATOR
AGP0215

TEACHING-5

COURSE FILES

CLASS LIST

Name SS no. Subject Matter Area

ASSIGNMENT 1

Assignment Header
(points, due date, etc.)

Subject Area	Assignment Problem Number 1 2 3 .....
1	
2	stored problem ID (P0215) (problem selection matrix)
:	
:	

ASSIGNMENT 2

:
:

ASSIGNMENT N

TEACHING-6

RESULT

Assignment Number Name: *Your Name*
Other Information
(Ex: Date Due, value, etc.)

PROBLEM 1
- Text with interspersed numbers
- Text and format specifications from problem text file
- Numbers randomly generated according to specifications in problem generator file
- Problem text used depends on your discipline area

PROBLEM 2

:
:

TEACHING-7

DECISION MAKING IN REGRESSION

LEVEL: Intermediate Graduate, Nonmajors

OBJECTIVES:
- * Comprehensive regression
- * Easy to use
- * Decision oriented
- * Instructionally oriented
- * Instructor controllable

DEVELOPMENT: Off and on since 1971

PRESENTLY:
- * Menu driven - states alternatives
- * Menu selections produce conversations, mainly yes/no
- * User can alter verbosity of conversation
- * Instructor controls availability of menu entries
- * Randomly generated data retrievable

TEACHING-8

COMPUTER DRAWN TRANSPARENCIES

> TRANSPARENCIES CAN HELP LEARNING
- Focus attention
- Allows instructor to accurately record details
- Can provide a record for absent students
- Keeps lecturer on intended track

> PROBLEMS
- Note taking difficult for students
- Lecturer may go too fast
- Handwritten ones may be hard to read

> SOLUTIONS
- Have computer draw sharp originals
- Reduce for students (computer can)

> ADVANTAGES
- Quicker than handwritten, or professional artist
- Storable for alteration

COMPUTER GRAPHICS

FOR

STATISTICAL TESTING

THIS IS AN IDEA UNDER DEVELOPMENT

OBJECTIVE: To provide a visual experience to complement usual lecture explanation

FEATURE: By providing an environment in which experimentation is easy and acceptable

HOPE: Some students who presently do not understand this idea may get a real second chance.

THE BOTTOM LINE

FRUITFUL USE OF COMPUTER ENRICHED INSTRUCTION REQUIRES:

- *OBJECTIVES*
- *PLANNING OF THE COMPUTER'S ROLE*
- *IMPLEMENTATION*
- *UTILIZATION OF STUDENT FEEDBACK*

===> IS IT EASY? *NO!*

===> IS IT QUICK? *NO!*

===> IS IT WORTH THE EFFORT? *YES!*

STUDENTS, LEARNING AND COMPUTERS: SURVIVING THE CHANGES

by

James C. Wade

University of Arizona

STUDENTS, LEARNING AND COMPUTERS:
SURVIVING THE CHANGES

by

James C. Wade*

Introduction

In the desert beside the massive Columbia River as it separates the states of Oregon and Washington, computers on large commercial farms daily call a computer at the local electric cooperative to determine the appropriate quantity of irrigation water to apply to the farms' crops. The quantities of water are optimized daily considering the age and type of crop, past irrigations and the recent local weather history. The cooperative receives satellite weather data periodically throughout the day from its solar powered weather station located among the farms. The data required for complex water management decisions are collected, analyzed and distributed on the cooperative's microcomputer and are processed on using similar computers. In Colorado and Nebraska, computer controlled irrigation management systems actually turn on and off the irrigation pumps to take advantage of time of day electricity pricing (Duke, et al., 1984).

These are not futurist views of agriculture. These and other similar applications of computers promise to create major changes in agriculture. American farmers have traditionally been rapid to adopt new production technology such as mechanization, hybrid seed and agricultural chemicals. Such adoptions have made American agriculture a model of efficiency (Thurow,

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1983). Sonka (1983) identifies three major revolutions in agriculture: substitution of animal power for human power, introduction of mechanical power and adoption of chemical-backed techniques, and emphasis on business and financial management for farm growth and/or survival (the information age in farming). Information based technological changes are already making significant changes in agriculture as the demand for important decision making information grows. Farmers are both consumers of outside information and suppliers of the internal information services required for effective business management. New agribusiness and government sectors are emerging to help provide computer and information services needed in agriculture. Knowledgeable and successful users of such information services increase their likelihood of survival in the competitive farm sector.

Although many anticipated computer innovations may be years away, recent changes are having major impacts on teaching. Educational institutions are pressed to produce students with at least the rudiments of computer knowledge, whether the student will work on the farm, in agribusiness or in government. Colleges of Agriculture, like other educational institutions, are searching for the best instructional uses of computers in their varied undergraduate and graduate programs. Rapid changes in the computing environment and insufficient experience and exposure of newly graduated students increase the urgency of the transition from traditional methods of teaching toward those that integrate computers into the overall teaching process. Students with better computer and information management skills increase their opportunities to survive and prosper in the food and fiber sector of the information age.

Economic survival in agriculture depends more and more on obtaining and successfully processing the information sufficient to assure a comparative production and marketing advantage. Table 1 lists some of the areas in which

Table 1. Information Environment in Agriculture

Marketing Information
- Output Price Access
- Customer Access
- Availability of Inputs
- Input Prices
- Weather Impacts on Markets
- Market Strategies
- News Related to Marketing and Production
- Inventory and Storage Control

Financial Management and Accounting
- Record Keeping
- Cash Flows
- Cost Accounting
- Cost Budgeting
- Investment Analysis
- Payroll

Production Decision Making
- Crop Mix
- Input Timing
- Production Risk
- Feed Mix

Extenstion Information
- Technical Advising
- Market Information

Scientific Control of Complex Process
- Milking
- Irrigation
- Feed Mixing
- Information Handling
- Input Monitoring

computers have been, or may be, of considerable benefit in farming. Other applications exist for the much larger agribusiness and related government sectors. It is readily apparent that most of these impacts are in the area of business management decision making, which directly impacts on the instructional programs of Departments of Agricultural Economics and Agricultural Business.

Providing agricultural students with a foothold in, and helping them become efficient participants in, the society is the goal of all instruction in Colleges of Agriculture. Increasingly, this goal requires knowledge of the functions and uses of information and computers in business management and economic policy analysis. The "information age" is upon University instruction.

The objective of this paper is to outline some approaches for using computers to aid in the teaching of students in Colleges of Agriculture and to share some ideas for improving instruction in the rapidly changing computer environment. The fundamental assumption of this paper is that computers are not the end but the means in educational computing. They are not a substitute for classroom teaching, but an aid in gathering and processing information that leads to effective knowledge of computers and how they may be used to solve problems, especially those of agricultural economics and agricultural business management.

This paper first outlines a conceptual relationship among students, learning and computers in university instruction. Next, the "ideals" and the "realities" of instructional computing are discussed. A prospective on moving from the reality toward the ideal is then developed from the author's Department's experiences in "muddling through" the changes. A summary and conclusion provides some keys to surviving the rapidly changing microcomputer instructional environment.

Students, Learning and Computers

The three most important aspects of computers in instruction are students, learning and computers. Bringing students to knowledge is the focus of all education. In this case, the goal is to integrate the use of computers into the education process.

Students

Students are, of course, the recipient of the instructional process and few university instructors misunderstand this idea. Students are why teachers and universities exist. But, to put students into the context of this discussion, some of their characteristics must be recognized. First, students in most academic areas have not come to the university primarily seeking an education in computer applications or computer science. Otherwise, they would have chosen those areas of specialization. Students in Colleges of

Agriculture, to some extent, are interested in the applied biological aspects of plant and animal production, in the technical systems used to manage these biological systems and/or the social and economic environment in which these processes are taking place. These students are not, and do not want to be, computer scientists. Students in these "non-computer" fields are, however, aware of the increased role of computers in the "information society" and that students in areas of study more directly related to computers (and engineering) have better job opportunities. Many of these same students have limited quantitative skills and, perhaps, even a bias or fear of computers and quantitative work. A few students view working at a keyboard degrading and mindless. Others recognize the benefits of knowing and applying computers in the chosen course of study but do not want to be burdened with the details of computer operations and programming. These students want and need to know how to use computers to supplement their applied discipline.

In summary, students are not as qualified as instructors might like but they are interested in learning to effectively use computers in their chosen area of study even though they may have no real idea what that learning might entail.

Learning

Having briefly examined students, instructors wishing to use computers in an educational program must examine their teaching goals. Once the goals are firmly established, means of achieving those goals may be defined tc include computers. Table 2 gives a partial list of the areas in which the computers may aid in university instruction.

In the disciplines underlying applied biological, physical and social science education, abstraction and theory of complex ideas play major roles in

Table 2. Roles of Information and Computing in Non-Computer Oriented Instruction

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Provide supplemental instruction (Tutorals)
Provide supplemental drill
Provide access to supplemental information
Provide examples
Provide easy anaysis of alternative solutions
Solve complex problems with large computing requirements
Knowledge of the role of information
Experience with computing environment
Testing
Accurate visual presentation
Hands-on experience

establishing a learning environment. Some such abstractions are never more than that to most students. While others may be developed into immediate and long lasting applications. Indeed, a common complaint of students is of a lack of usefulness of the ideas provided in, for example, economics classes. Clarification and utilization of abstraction and formal decision rules through examples, drills and exercises are, indeed, often a major portion of most educational programs. Applications have always been the key distinction in the linkage of complex ideas to agriculture since the goal is to efficiently produce the crops and animals required by a growing society. For this reason, agricultural education has always placed a strong emphasis on laboratories and field trips in its classes.

"Learning by doing" is one of the oldest maxims of education. The concept of applied/hands-on experience is a primary component of modern learning systems, especially in the sciences and agriculture. Laboratories have become an essential element in the continuing scientific revolution. The fundamentals of theoretical and conceptual analysis and the factual knowledge provided in classroom lectures notwithstanding, the practical experience of "doing" is essential to the precepts of beneficial education. The subject may be writing, mathematics or technology. Inexpensive computers and related electronic technologies have the potential to influence classroom applications by providing more opportunity to apply the knowledge learned from conceptual analysis.

Facts, another mainstay of education, if presented in a void of conceptual ideas, provide little opportunity for learning. Data may be increased, but useful information and knowledge may not be increased. Integration of concepts, theories, hypotheses, inquires and information are at the heart of modern learning. Separating, categorizing, and utilizing important information is essential in testing and applying conceptual ideas. The drudgery of such work is reduced by the supplemental use of computers.

Thus, a summary question is "What are the goals for using computers in instruction and do they blend into the overall objectives of learning?" Is the goal to supplement teacher and tutoral shortages by substituting computers? Is the goal to teach basic computer use and programming? Are computers to store and retrieve data and information? Are computers to be used to clarify abstract conceptual ideas through applications, demonstrations and examples? Some (e.g., Litzenberg, 1982) assert that computer programming is a prerequisite for computer based learning and that computer literacy requires a knowledge of how computers function and how software is designed. Are these requirements part of the goals of instruction in the parent discipline? And finally, can learning of the central elements of the discipline be improved using computers? If not, then compuers may not be needed in instruction.

All of the computer uses suggested in the previous paragraph are valid to some degree. However, in agricultural economics, the primary goal is to train knowledgeable decision analysts and decision makers, whether they are producers, agribusinesses, or resource or policy analysts. Computers are simply tools for aiding this process.

Computers

The evolution of computing hardware and software are the factors that give impetus to the urgency of the questions addressed in this paper. In less than five years, the computer industry has been revolutionized and the concept of personal computing has become a reality. Problems that only a few years ago would have required a large mainframe computer now can be solved efficiently using "desktop," or even "kneetop" computers. Computing power is in smaller, cheaper, and easier to use packages.

A software revolution is following the hardware revolution and software ultimately provides the key to educational use of computers. Applications software design has dramatically improved over the past year. Integrated word processing, spreadsheet and graphics systems are readily available (although not always inexpensive) for almost every make of microcomputers. Decision aids and information handling software for various applications, from accounting to statistical analysis, are expanding rapidly. As availability and competition expand, prices decrease and capabilities increase. These software aids, designed for efficiency by knowledgeable computer users, utilize the full power and promise of microcomputers by using efficient data handling, interactive computing and full screen graphic display. New software is designed to be as "transparent" as possible for the user. As a result, user burden is minimized.

Rapid change in computing hardware and software is the current and foreseeable state of the art. Hardware or software purchased today is superceded by more powerful and cheaper versions in just a few months. Stabilizing instructional computing in such an environment is, at best, difficult especially for a faculty that is primarily interested in the concepts and applications of their discipline. Generating new and truly unique computer applications for instruction is all but impossible. Just keeping up seems impossible. Many faculty simply will not bother.

The availability of powerful, inexpensive computing aids the underlying concept of the educational process by allowing students to have meaningful hands-on experience at a relatively low cost and with considerable ease. It is tremendously important that at least some instructors lead the way in developing solid educational applications for microcomputers in disciplines where they enhance existing educational goals. By briefly examining the "ideals" and the "realities" of microcomputing in an instructional environment, this paper seeks to enhance the understanding of the alternative uses of computers in instruction.

The Ideal Instructional Computing Environment

Proper integration of students, learning and computers should lead to an ideal instructional computing environment. The key elements of this environment for non-computer disciplines are outlined in Table 3. The ideal operating environment is largely transparent to the student and the instructor. In such cases, the student has a knowledge of the basic operational procedures of, and some experience on, the computers available. A previous fully integrated and coordinated course of studies has prepared the student to use microcomputers, at least to a limited extent. The student knows how to efficiently use the keyboard and has no inherent fear of computing. The student understands the basics of mathematics and equation

Table 3. Ideals for a Computer Instruction Environment

Student Literacy
- Knowledge of the Basics

Well Integrated Educational Goals
- Administrative Support
- Conceptual Integration
    - Innovative and coordinated goals
- Knowledgeable Administrators
- Support Personnel, Supplies and Maintenance
- Software
    - Innovative and coordinated to goals

Student Access
- Hardware Availability
    - Compatible and inexpensive
- Small Groups
- Software Availability
    - Compatible and inexpensive

Well Structured Software
- Drills and exercises
- Tutorals
    - Computer Literacy
    - Concepts and Theories
    - Introduction to Software
- Problem Solving
    - Statistics
    - Spreadsheet
    - Operations Research
    - Financial Analysis
    - Accounting

Instructors
- Know Concepts
- Know Software Use

structure. In short, basic computer literacy already exists so that the operational aspects of computing need not be retaught. All students are be more or less at the same level of knowledge.

The ideal computer facility, or laboratory, is supplied with up-to-date microcomputers including, at least, a printer and for each computer, graphic video output. Memory and data storage devices are adequate for the largest software requirements. Each machine has a telecommunications access to data utilities and other outside larger computers. A sufficient number of identical computers are available. Few, if any, students are waiting to use the computers. The laboratory is spacious and pleasant. Machines and students are placed so that distractions are at a minimum. Conflicts of time and space do not exist.

In an ideal instructional environment, administrators at all levels, from Department Heads to the Legislators, are knowledgeable of, and appreciate the use of, computers as intructional tools. Adequate support personnel, supplies and maintenance are provided. Instructors are rewarded for innovative teaching in a well understood and coordinated way. No conflicts exist as to which departments are to teach which materials and maintain computer laboratories. Every department that wants a laboratory has unlimited access to one.

Software, the brains in the ideal computer laboratory, is easily chosen from that readily available in the software market and funding exists to purchase, in large quantities, the exact software needed for each instructional goal. If not available on the market, an expert programming staff is available to design the needed software. Drills, exercises, tutorals, and problem solving units are precise and serve exact educational needs. Instructors are fully knowledgeable, do not make mistakes, and integrate the software presentation into other material given the student.

The "Ideal Instructional Computing Environment" is, of course, only a goal. Perhaps, the "ideal" presents nothing more than the way changes may ultimately provide for future instructional computer use. In the meantime, instruction is carried out in a more "realistic" environment.

The Real Instructional Computing Environment

The "real" instructional computing environment is much the opposite of the "ideal" presented in the previous section. Demands from students, parents and administrators seek increased and improved computer skills without providing the resources needed to meet these demands. Like other laboratory sciences, the benefit of computers in instruction is in the hands-on experiences of the students. However, computer laboratories for instruction are assumed by some administrators to be necessary for "computer sciences" and "engineering", but not for other academic areas. Such laboratories, if ever built, are assumed to retain their usefulness almost indefinitely and are costless to maintain. The rapid change in software and hardware is not fully acknowledged. Computing laboratories are expensive to establish, supervise and maintain. Space is usually limited.

Thus, the instructional laboratory in a "non-computer" discipline, in reality, is a few (if more than one) microcomputers or mainframe terminals in a small unused storage space or in a faculty member's office. Cramped conditions endanger equipment and limit learning potential. Limited equipment create over use further shortening the useful life of the equipment. Graphics presentation may not exist, or is very limited, and printers are often inconveniently shared. Telecommunications is restricted or nonexistent.

Many students enter courses that use microcomputers with little or no previous training. The instructor teaches "computer literacy" and, thus, removes a bit of material from the original planned course outline. Many instructors find the benefits of computer base instruction large enough to warrant the rescheduling of other activities. Instructors often lack knowledge of the potential uses of computers in instruction, of the method of coordination of computer aids into their instructional goals and of the available software for their application. A majority of instructors could not, or would not, write software for such computer based applications. Knowledgeable programming or teaching assistance is rarely available. Little or no academic recognition is provided for innovative teaching and software design in most large universities.

Software cost is high, especially if several different software packages are being used in a computer laboratory. Of course, software packages are not directly available for many conceptual ideas of primary concern. Software application is the central focus of instructional computing. If instructors are waiting for an ideal software package to aid the learning of difficult concepts, the wait may be quite long. In fact, the instructor may need to write, or hire a programmer to write, a program if the software need is ever to be fulfilled. Funds for such activities are limited.

Although limitations on software for university level instructional use appear to be very severe, these limitations are primarily in the areas of preprogrammed tutorals, drills and examples. Software markets have greatly improved for business and accounting, statistical and operations research software. These, usually expensive, softwares are often discounted in volume to educational users and provide an ideal base from which to develop the types of educational application that best fit many university instructional environments.

Given the realities of the instructional computing environment, what approaches are appropriate and how can they be implemented? To illustrate one approach, the following section describes the recent efforts in the Department of Agricultural Economics at the University of Arizona to utilize computers as a component of instruction. Efforts that are less than perfect but efforts that provide a beginning.

Muddling Through: A Case Study

To place some prospective on the potentials of and approaches to microcomputer in instruction, the Department of Agricultural Economics at the University of Arizona is used as an example (see Wilson, 1984). The Department has approximately 28 microcomputers to service 16 full-time faculty plus support staff in teaching, research and extension. Microcomputers are an important element of office productivity and the research and extension programs of the Department. Additionally, eight of the 8-bit CP/M based microcomputers are dedicated to instructional use.

The Department's 22 courses are taught once each year. Class sizes are relatively small, ranging up to approximately 60 students. Twelve faculty positions provide full-time equivalent instructional faculty of approximately 3.12 faculty years/year. The Department has one half-time teaching assistant who works primarily with computer oriented courses. The Department has 27 graduate students. The Department services some instructional needs for other departments of the University. Instructional computer use is carefully limited to a role of supplementing existing courses in Farm Management, Financial Analysis, Production Economics, Agricultural Marketing and Demand Analysis, and Applied Operations Research.

The last two of the courses listed above are graduate courses and reflect the traditional linkage of computers to applied research in agricultural economics dating back some 20 or more years. Graduate instruction traditionally includes at least some instruction in, and experience with, computer software and, to a lesser extent, computer programming. Particular applications center on statistical analysis (including econometrics) and mathematical programming. At the University of Arizona, graduate class sizes are relatively small (10 to 30 students) providing for significant individual instruction.

The traditional approach to graduate instruction has been to assign students small to moderate size problems for analysis. The students are given minimal instructions of data entry and formating and are left to determine how the problem is to be solved using the assigned software. Students must setup the problem properly, convert the problem to the nomenclature of the available software and produce and analyze the solution. These computer related assignments have primarily been in the areas of mathematical programming. The software interfaces have been primarily through batch card entry since student access through timesharing is somewhat limited and cumbersome. In recent years, some of the data management and other functions of instructional applications have been shifted to timeshare/ interactive computing on moderate to large computers which serve as "frontend processors" for the large mainframe computers. The students correctly perceive this approach as antiquated and resist learning such processes. Many have never learned to use a card punch or card reader and see little need in doing it now. Experiments using timeshare systems as frontend processors for the batch input have proven less than satisfactory since few students have experience with line oriented text editors.

Although this traditional approach is limited, substantial learning in problem applications is accomplished. The transition from batch to timeshare to microcomputers is underway but limited by available applications software and timeshare access. It seems appropriate to jump over this stage and move directly to microcomputing as a substitute.

Formal microcomputer use in graduate courses has, thus far, been limited to a few test cases in linear programming and statistical analysis. However, for many applications at the graduate level, efficient software for microcomputers is just now becoming available. As microcomputer/software capabilities improve, all but the largest statistical and operations research applications will be solved using microcomputers.

Graduate student learning on microcomputers is a more informal process. Most graduate students see immediate applications of microcomputers for word processing of papers and theses, and some for other applications. The microcomputer laboratory (including some additional machines dedicated to research) is made available to graduate students without supervision on essentially an unlimited basis. Thus, students recognizing the potential cost savings of the word processing teach themselves. Ultimately, they learn software necessary and valuable for carrying out thesis research. A few even learn to program in the languages available to them, although learning to program is not usually necessary. This informal learning is an important aspect of graduate training.

Computer applications in undergraduate instruction have historically been less because of software complexity. Some of the applications software used in graduate courses and in research has been used with limited success at the undergraduate level. Because of required background and experience to run large mainframe software packages, these software applications at the undergraduate level have been met with mixed results. The applications and software are simply more advanced than needed at the undergraduate level. Microcomputers are changing this complexity and providing significant opportunity for increased instructional applications.

In the Fall of 1982, the first attempts were made to use microcomputers as an aid in undergraduate teaching after the Department received a small gift from CALCOT-Seitz Foundation to purchase a few portable microcomputers for instruction. Although the computers arrived later in the semester than was desirable, some applications were developed and successfully carried out in this first semester. Several factors, besides the late arrival of the computers, affected the first attempt to use the microcomputers to supplement classroom instruction. First, since adequate space was not available to establish a student laboratory, the instructors attempted to setup the microcomputers during regularly scheduled classes. The computers had to be removed immediately following the class. This idea seemed reasonable since the computers were portable. For introductory instruction, this arrangement was adequate, although additional personnel were required for equipment setup and monitoring. The most limiting part of move-in/move-out instruction is that it does not provide "out-of-class" access to the computers so that each student may spend some hands-on time learning the functions of each key and the subtleties of the software and to experiment with applications.

Although student enthusiasm was high and some learning of microsystem and software applications did occur, the overall experience called for a change. For the second and third year, a small microcomputer laboratory has been established which provides students with substantial time (7 hours per day) for experimentation and applications. Although the laboratory is cramped and access limited to eight microcomputers and two printers, this laboratory is proving a popular addition to the Department's instructional program.

The instructional goals and the approach to computer use in the Department are to use microcomputers and, with preprogrammed software, to aide in solving problems of interest in Agricultural Economics. The computers are used as laboratory tools and their use is flexible within the context of available software. Since emphasis is placed on applications, minimum start-up instruction is required and students can be involved in applications of their own within minutes of first coming in contact with the computer. To break the computer ice and to put the students at ease at the keyboard, initial applications are to type a business letter or research report using word processing software. A tutoral program is available on the word processor and students are given an instruction sheet with which to get started. Each student is required to provide their own applications diskette. Perfection is rarely obtained on the first exercise. But, as experience and acceptance increase, class assignments improve in quality of presentation and analysis. Additional assignments in the undergraduate courses include designing spreadsheets to coordinate data and to analyze farm management problems such as farm enterprise budgeting, cash flow analysis and capital investment analysis. Students are not given spreadsheet templates into which they simply plug numbers. If they are to successfully apply microcompuers when they leave the University, they must know the basics of software structure and applications. Computer programming is not taught but software applications are taught within the full context of the software. This approach, although more difficult for instructors, is proving beneficial for students.

In more abstract courses, such as Production Economics, spreadsheet analysis is used to augment the learning of decision processes involving production functions, budgeting and time value of money. In addition to spreadsheet software, applications are also developed on preprogrammed software for investment analysis and linear programming.

The experiences of the Department and the faculty most directly involved in computer use in instruction have been mixed. The faculty sees good potential for improved student learning of fundamental concepts. The transition from mainframe to microcomputer has not been easy and is far from complete. As the faculty learns the benefits of microcomputing, objectives must be clarified, capable teaching assistants must be acquired and software must be evaluated, purchased and applied.

Keys to Survival

In summary, microcomputers for instructional use are still primarily a promise in most university applications. Junior and Senior High Schools are often better equiped for providing microcomputer instruction than are universities. Perhaps much of the basic instruction in computer literacy should be left to secondary schools and community colleges. However, university instruction can profitably use microcomputers to enhance the learning experience by using them as tools to aid students learn applications of primary concepts. The reality of resource shortages, indifference and resistence to rapid change can be overcome by individual departments and instructors who struggle to survive in the microcomputer instruction world.

Some keys to surviving the changes are briefly outlined below:

1. Know your students and your instructional goals. For educational goals, like all other goals, getting there is more difficult if you don't know where you are going or the vehicle which is to be used. Understand student needs and wants. But don't compromise on sound instruction of basic disciplinary knowledge.

2. Know and use your computers. Instructors must know their equipment and its uses (including software) to be able to recognize new opportunities for application. Those who know are better able to teach. Teaching by example is easy in computing. Be involved in all aspects of the computing exercise.

3. Use student-friendly applications software. Learning concepts is much easier when students do not have to overcome a lot of user burden to apply the software. Emphasize applications software that is easily applied to the overall instructional goals. Don't teach computer programming. Do provide the students with help.

4. Keep it simple but push the student. Place problem solving and concept applications as near as possible in a real world context. Students working alone may have difficulty handling the data and calculations. But, students, microcomputers and software can handle a lot more data and calculations. Students' use of the software should be simplified, but not below the student's capabilities.

5. Let the students do the work. Some students learn faster than others and sometime equipment, software and students take some time to ripen. Be patient, flexible and let the students do the work. Let students use software to create their own spreadsheets and solution files for problem analysis. Make the students work for answers. In this work learning occurs.

6. Don't lie and be willing to admit a mistake. Don't oversell students on the computer's capabilities. They will only be disappointed. Let them know early that computing takes work, but that it usually is rewarding. If you make a mistake, admit it. Neither computers, students nor instructors are perfect.

7. Know the limitations. Not every computer can do the same tasks, neither can software or instructors. Not every application should be solved on a computer. Don't push beyond the limits. Don't write software, use software.

8. Always look for something new and upgrade. Keep checking with friends, colleagues, dealers, journals and magazines for new applications for software and hardware. Search out the alternatives. Do example problems and experiment. Be ready to change.

9. Find the money somewhere. Microcomputing is expensive and the funds are not always available in standard instructional budgets. However, other sources of funds or products exist. Hardware and software producers often reduce the price or give equipment to universities, especially for classroom users. They fully recognize the market enhancement of educated computer users. If computer instruction is an important part of the educational goals, push for the resources needed to enhance the goals.

Change is reality. Information, knowledge and learning help the world deal with change. The universities' goals are to improve the understanding and application of knowledge to the realities of the world. Computers in instruction can make this process much easier.

Students who have learned their lessons are able to leave the university and use the microcomputer tools available to help solve the decision problems facing them in business, industry or government. A computer is but an aid. Basic knowledge must be instilled in every student, whether or not computers are used in instruction. The computer must never become the end.

References

Duke, Harold R., Dale F. Heermann and Michael C. Blue, "Computer Control of Irrigation for Electrical Load Management," Transactions of the ASAC, Vol. 27, No. 2, pp. 597-602, 608, 1984.

Litzenberg, Kerry K., "Computer Use in the Agricultural Economics Classroom," American Journal of Agricultural Economics, Vol. 64, No. 5, December 1982, pp. 970-977.

Sonka, Steven T., Computers in Farming: Selection and Use, McGraw-Hill Book Co., New York, 1983.

Thurow, Lester C., "Farms: A Policy Success," Newsweek, New York, May 16, 1983.

Wilson, Paul N., "Department-Based Computer Instruction: Experiences for Agricultural Economics," mimeograph, Department of Agricultural Economics, The University of Arizona, April 1984.

COMPUTER AIDED INSTRUCTION FOR FRESHMAN CHEMISTRY AT THE U.S. AIR FORCE ACADEMY

by

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COMPUTER AIDED INSTRUCTION FOR FRESHMAN CHEMISTRY AT THE U.S. AIR FORCE ACADEMY.

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This paper presents the computer aided instruction (CAI) system used for freshman chemistry at the USAF Academy. This CAI system utilized four approaches to help the student master the fundamentals of our first-year chemistry course: (1) drill/practice/tutorial, (2) laboratory calculations, (3) laboratory simulations, and (4) "games". Our drill/practice/tutorial programs cover most topics taught in our course. The laboratory calculation programs help the student understand the experiments he/she performs in the laboratory. The laboratory simulation programs are used to "run" an experiment, a pH titration, for example, at a computer terminal. We use games to stimulate and maintain our students' interest while they learn chemistry. These games include a real-time, 10-level "dungeon and dragons" adventure game named ALCHEMY. The student's key to survival in ALCHEMY, of course, is knowledge in freshman chemistry.

During the past 4 years, the Department of Chemistry at the Air Force Academy has developed an extensive system of computer aided instruction (CAI) for students and computer management tools for our instructors. Our focus has been on developing programs for the freshman class in general chemistry. Every student enrolled in our freshman course is given an account on the Academy's general purpose computer system (VAX 11/780). A student who logs into the system will be offered a menu of choices, one of which is Chemistry CAI. When the student choses Chemistry CAI, he is presented with a list of chemistry related programs. These programs are designed to help the student in four general areas.

- Drill and tutorial of basic concepts
- Laboratory experiment calculations
- Laboratory simulation
- Chemistry games

We have many programs which provide tutorial instruction of basic freshman concepts such as stoichiometry, electronic configuration and gas laws. In addition to tutorial instruction, students may choose to receive questions from the computer to practice what they've just learned.

We also have a series of CAI programs which help the student perform calculations required for their laboratory experiments. Each of these programs present the student with a replica of the laboratory data sheet which the student completes. Given the student's data, the computer calculates the correct answer. The student can then check to see if he performed the calculation correctly. If he did not, these CAI programs lead the student step-by-step through the correct calculation method.

We also have programs which simulate laboratory experiments. Our most successful venture into this area so far is a simulation of an acid/base titration experiment using a pH meter. Since we must teach about 200 students during a single time period, a titration experiment involving the use of a pH meter represents a large investment in equipment. Usually, this leads to the use of phenolphthalein as an indicator to find the equivalence point during the titration, rather then using the pH meter. Thus, we have the need to provide the hands-on titration experience, but we don't have enough equipment to do so. We feel a computer simulation is a good compromise. This particular graphics program is run on color TERAK terminal interfaced to the VAX 11/780.

A student can successfully simulate the pH titration experiment on the computer. He has available all the normal glassware and solutions he would have in the laboratory. The computer selects an unknown acid and from the titration curve, he can calculate the ionization constant (pKa). We have several options we can employ depending on the situation. The program can give the student a standardized sodium hydroxide solution or force him to standardize with potassium hydrogen phthalate. The acid can be pre-selected or it can be an unknown acid. The program itself is written in a user friendly manner so that the student does not have to learn a set of syntax rules to communicate with the computer. It also does the necessary bookkeeping for the instructor.

We also have a few chemistry games designed to help the student learn chemistry while he is having fun. One of these programs is a nomenclature game called, appropriately, NAME GAME. Students are given 3 minutes to correctly answer as many questions as they can. Points are awarded or deducted accordingly.

Another popular game we utilize to reinforce basic concepts is ALCHEMY, a dungeons and dragons adventure type game. Unlike most adventure games, however, ALCHEMY does not require a player to learn his way around a maze, only that he correctly answer chemistry related questions when asked by one of Alchemy's resident creatures. If a student misses a question, the creature always gives him a reference to look up the answer.

Students are told that CAI is a tool designed to help them learn.

Hopefully, it will be fun and challenging. Students are reminded to use it as any other study tool. They are encouraged to use it only if they find it helpful.

Our CAI is used extensively by our students. During the first 4 weeks of this fall semester, there were over 22,000 separate program runs. The total program run time exceeded 1,700 hours.

The Department of Chemistry also uses the computer as a management tool. We use the computer to store test questions, to automatically generate tests and to manage our grades. For example, we have several data banks of test questions (PDP 11/70). This data base not only includes the test questions, but also includes the selectivity and ease index of the questions, key subject words, and source of the questions. We've written a program which can utilize these data banks to automatically generate the test in the proper format. Test questions may be selected manually or automatically by subject. This has the potential of saving our department a great deal of typing time. We also have a very large data base that manages the students grades (VAX 11/780). Instructors can easily and quickly store, retreive and print student information on a course section or individual student basis.

One other instructor program that is a tremendous time saver is our LABEVAL program (Burroughs 6900). When the students finish a laboratory experiment, they code their data on an optical scanner sheet. The computer reads these and performs appropriate calculations (usually includes per cent error) using the student's data. Hardcopy output of data and results are provided to the instructors and, eventually, the students. In checking the students' lab report, the instructor can very quickly see if the calculations were performed correctly. If they were not, the error is easily pinpointed.

Finally, a word on the Academy's Microcomputer in the Dorm or MID project. The Academy's goal is to have a microcomputer in every cadet room by 1987. These microcomputers will be networked to one common computer system. They'll be used as word processors, as CAI delivery systems, and as communication links between students and instructors. The specific microcomputer has not been selected at this time.

BASIC SKILLS: DEALING WITH DEFICIENCIES

by

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Basic Skills: Dealing with Deficiencies

My experiences with developmental education began in the mid-60s when I began teaching at El Centro College in Dallas, Texas. I was fortunate to be welcomed as a developmental education teacher--at least by the administration--into a college administered by a president and deans who firmly believed the our remedial/developmental students were as important as any other students on that campus; their welfare was of great concern to those in charge of that college. The faculty, counselors, and students in our little department enjoyed a fiscally-safe, comfortable setting; we were genuinely awarded security and status in a time when teachers of remedial courses were not so well-regarded (in fact, there was usually some suspicion--sometimes voiced--about one's intelligence and "real" qualifications for teaching in college if these were your assigned courses). As I became familiar with other developmental programs around the country and as we became almost a national laboratory for visitors interested in designing their own, I was amazed to find that I was in a unique situation. Later on, I realized that one of the essential ingredients to our success was the characteristic that Texans like to assign to themselves; we were a very "can do" group--we simply did not know what we couldn't do! And that was a very real advantage in those days! In fact, thinking back on them, I am amazed that we entertained such "Pollyanna" ideas. To illustrate, a wonderful woman on our developmental faculty was putting several children through college; she was especially dependent upon getting that paycheck at the first of every month (she wasn't alone, I must confess, just somewhat more desperate than the others). And she was especially concerned for several years that we were doing too good a job--that is, we were doing such fine work with these low-achieving students that we might just be working ourselves right out of a job! I recall that, in fact, we all shared some ideas that this could well happen and that we should give serious thought to other courses that we might wish to teach next. But, sadly, she was absolutely dead wrong! It seemed that that harder we worked, the behinder we got. What we found was that we had a very successful program by anyone's standards--and particularly by the national standards--as 90% of our students were successful in that program and a large percentage made it elsewhere as well. But our problems were growing.

Just as we thought that we had identified the nontraditional student and were making a significant dent in meeting their needs--we could accommodate the students that were needing our help--we began to find that numbers of more traditional students were demonstrating skill levels that looked, strangely and surprisingly, more and more like (upon assessment) the less academically prepared students that we were most accustomed to seeing in our classrooms. By the time I left El Centro, we were one of the largest departments on the campus.

Some of our experiences on the national level provided glimpses that we were not alone. I recall that in the late 60s, my colleague and I were in a limousine carrying several college/university English teachers to a CCCC's meeting. We overheard them talking among themselves about the program, that this year the conference coordinators had--great horrors--scheduled a workshop on remedial education, and they wondered just how many of these "remedial types" would be in attendance! Only five years later, the CCCC's program listed more remedial/developmentally-focused workshops than workshops with more "traditional" themes.

A Brief History

In 1968, an in-depth study of early remedial efforts in college found that very few of the students who were placed in remedial courses ever completed them; in fact, 90% either failed or withdrew. Sometimes these courses were required; sometimes they were merely offered, but the results were always disastrous as early programs were usually very poorly conceived and very poorly implemented. In fact, very often the early remedial programs were either "watered-down" versions of the regular college courses or were unreasonable facsimiles of elementary school courses that were badly redesigned for adult learners (Roueche, 1968). A study in 1973 again studied developmental programs and identified successful programs in five community colleges and highlighted the components that appeared to be common elements. This study found that the students persisted at high levels to program completion and that they were, indeed, learning to read, write, figure, and study well enough to enter other college courses and do well there. Furthermore, it was discovered that faculty who taught these courses brought much enthusiasm and high expectations for student success into these classrooms. Above all, the results documented that low-achieving adults had simply never been taught--that they did possess the abilities and motivation to be literate; they simply had not been prepared well academically (Roueche and Kirk, 1973).

A follow-up study in 1977 looked once again at developmental programs in hopes that--through careful documentation on the part of the institutions--there would be proof that these programs were making a difference and that students were successful in those programs and in subsequent courses. While discovering several successful programs in both colleges and universities, the researchers found that most institutions could not document program success. That is, although their curriculum and policies were based upon premises that students could learn and that they should be appropriately placed in courses where they could receive adequate preparation for college-level work, most of these institutions could not report how many students completed the developmental program, how many persisted in regular college courses and with what success, and whether or not the developmental effort was of any value either to the student or to the institution (Roueche and Snow, 1977).

During these years, reports continued to surface that many of the most selective and prestigious universities were experiencing a major problem with students who could not demonstrate basic skill levels that were acceptable for college-level work--yet their high school transcripts reflected, ostensibly, very solid work! For instance, Stanford had established a learning assistance center in 1972 for the provision of remedial programs, and it found that within four years, 50% of its freshmen were receiving academic assistance and guidance. In 1975, the University of California was requiring remedial writing of at least 50% of its students--students drawn from the top 12.5% of California high school graduates. Strangely enough, that same percentage of students were assigned remedial writing courses at Bronx Community College--a college admitting three-quarters of its students from the lower half of New York City high school graduating classes (Maxwell, pp. 229-30).

The NIE Studies

In 1979, the National Institute of Education funded two three-year, in-depth investigations of literacy development in selected community colleges in Arizona and Texas; funding went to the Arizona State University and the University of Texas at Austin. The parallel research studies were looking at literacy development strategies in all programs and courses at these colleges--not just the developmental courses. The studies were conducted independently of each other, but their findings were remarkably and sadly similar.

Both studies discovered that students were expected to read and write more frequently and with more precision in the developmental--or basic skills--courses than they were ever required to do again (in regular courses). In fact, the two studies documented that students in these colleges were rarely expected to demonstrate literacy skills that had been traditionally regarded as expectations for college work (Roueche and Comstock, 1981; Richardson and Martens, 1982). To be more specific, reading and writing assignments requiring more than brief skirmishes with written language were rarely made in any regular college courses; a large percentage of the students in any class never bought the text or lab manual as they had discovered early on that reading these materials was unnecessary for successful course completion; many instructors never made assignments in the text, and if they did they never evaluated that reading; fragmented pieces of information would be carefully identified as "important" reading or would be included on hand-outs and would appear in similar fashion on the next examination. Typically, students were required to do little more than recall and produce very fragmented, disjointed pieces of information. I and my colleagues in the UT study did discover that in courses with value, use, interest, and relevance to students' personal learning goals, they were much more likely to produce work at higher levels than was expected in the minimum requirements. In those more general courses where the content was of no perceived value or interest and had no clear relationships to any other coursework, students were more inclined to accomplish only minimum requirements and do so badly.

Another discouraging joint finding was that instructors infrequently talked to each other and could not generally articulate relationships between their course content/demands and/or any other courses required of students in and out of that discipline. General education courses (Freshman English, for example) taught writing styles and models that were never used again by students. In other words, there was little, if any, knowledge about the language requirements and applications in those courses for which they were ostensibly preparing students. As a result, it is obvious that we found little evidence of application or transfer of language skills from these general and/or developmental courses to any others in the college curricula.

One of the most unsettling joint findings was that of the isolation of the basic skills instruction from the rest of the college curricula. That is, the reading, writing, and math courses were very often taught without any identified relationship--or apparent regard for--any other courses for which students would enroll. It was as though the skills could be taught outside of any meaningful context--that they were somehow important learnings all by themselves.

By and large, both studies demonstrated that attention must be paid to reasonable levels of literacy skills in all courses and programs. They shared a concern that instructors--faced with great diversity in the classroom--(no mandatory placement for basic skills development prior to enrolling in regular classes) were resorting to reducing instruction to the lowest cognitive levels--rather, demanding little if any demonstration of acceptable basic skills. The vicious cycle was obvious!

The University of Texas Study

During the spring and summer of 1982, Drs. John Roueche and George Baker, and I, conducted a national study of college and university responses to low-achieving students. This study was the first of its kind and surveyed all community, junior, and technical colleges, as well as all senior institutions awarding the traditional associate, baccalaureate, and graduate degrees. Of the 2508 surveys mailed, 1489 were returned, of which 1452 were usable. Of that total, only 160 institutions reported that they had no basic skills programs, courses, or alternatives for serving low-achieving students. It must be mentioned, at this point, that of those 160 institutions reporting no basic skill development activities, several have been featured in professional articles about their own existing developmental efforts and/or the problems that they are facing with the increasing numbers of students demonstrating poor skill levels. As well, several of their staff and faculty have been quoted as to their personal institutional concerns about the growing national literacy problem and the fact that there is dramatic evidence of same on their campuses. While we can only speculate about why these institutions chose to respond as they did, the responses merely convinced us further that no matter what the response, there are multitudes of all levels of postsecondary educational institutions that are being hit squarely in the nose with a growing problem.

This survey sought answers to the following questions: what is the magnitude of the literacy problem that colleges and university are facing? what institutional efforts are in place to devevelop basic skills? how effective are these efforts? what are the common elements of reportedly successful programs and courses?

Unfortunately, it was difficult to identify successful programs from survey responses; institutions were noticeably lax in collecting and reporting retention in their follow-up data. Therefore, the inconsistency of these responses provided a very tenuous base for making evaluations of program success. In fact, most of these responses led us to suspect that the retention information was most likely someone's guess about how well the programs were serving students. We found that the institutions that did collect retention data most typically were recording only retention figures for the basic skills program, not the figures for students who were successful in courses taken after completing the basic skills sequence. We did, however, communicate directly by phone and in writing with those programs that reported 50% or better retention in basic skills programs.

From these personal interviews, we gathered enough additional data to infer some elements of success: that is, we identified those elements that (1) appear to best predict success with low-achieving students, and (2) are most characteristic of basic skill courses that report successful outcomes. Our additional data, in combination with initial survey responses, provided us with eleven elements that we identified as being common to reportedly successful programs. They were: strong administrative support, mandatory counseling/ assessment/placement, structured courses, award of credit, flexible completion strategies, multiple learning systems, volunteer instructors, use of peer tutors, monitoring student behavior, interfacing with subsequent courses, and program evaluation (Roueche, Baker, Roueche, 1984; Roueche, S., 1983; Roueche, J., 1984).

Administrative Support. Successful programs and courses are provided strong administrative support. Board policies, college and university catalogs, and student handbooks include statements that the institution plans to share the responsibility for the success of its students and translate those statements into such activities as student assessment and placement into appropriate courses and college interventions when poor academic performance threatens students' continued enrollment in the institution. A notable example of this support is in practice at Miami-Dade: an institution-wide (including basic skills courses) strategy for improving retention, the Academic Alert System notifies students--after approximately one-third of the semester--who are not performing at acceptable levels in their course work. Notification includes instructions about recommended action: students are to see a particular counselor or tutor on a specific day, at a specific time. There is some proactive effort to remedy the causes of the student's academic difficulties before it is too late. Enrollment practices at Duke University and at the University of Arkansas at Little Rock (to name but two) require students to take basic skill courses--if assessment indicates that they are needed--prior to enrollment in any other college courses: taking the basic skill courses is a condition for enrollment; and at the University of Arkansas, there is a formal contract drawn between the student and one of the academic deans about this required plan. Breaking the contract means suspension from the institution and no permission to reenroll.

Mandatory Counseling and Placement. These institutions go beyond merely writing about strong support--they require mandatory assessment and placement! Students, upon entering the institution, are tested for basic skill development;and based upon the results of these tests, they are advised and then placed into courses designed to prepare them for college-level work. In fact, the mandatory assessment and placement means that students with reading/writing/math deficiencies will not be allowed to enroll in any courses where those skills are required until the institution determines that performance is at the appropriate level.

Mandatory counseling includes making additional requirements of students. Students may be allowed to take only an acceptable number of course hours in light of family and work responsibilities and assessment test results. It is understood that enrolling a student in a full-time schedule when outside responsibilities threaten to negatively affect academic performance is professionally irresponsible. Counselors also tend to rely less heavily on high school grades as indicators of students' abilities to succeed in college and rely more heavily upon standardized tests--e.g., SAT, ACT--as measures of academic potential. However, because the standardized tests merely indicate where there are basic skill problems--that is, they identify students without providing specific problem areas--institutions are attempting to use more on-site testing for an in-depth analysis of deficiencies. These analyses may be made during the orientation or the registration period and/or once the student is in the basic skills course.

Structured Courses. While we found that institutional size was a major contributing factor in determining programmatic structure of the basic skills effort, all of the courses were very structured, very organized. For example, the courses would meet regularly, student performance was monitored, and strict attendance policies were in effect. These courses typically carried grading systems that included one non-punitive grade--to be given to students making acceptable progress but not yet meeting exit requirements. The "progress" grade protects the student from academic suspension and gives him additional time to meet course requirements. Again, institutional size appears to be a factor: while courses may be housed in separate developmental departments, they more frequently are housed in separate academic departments in the smaller institutions. In larger institutions, they are usually housed in learning resource centers which serve the rest of the institution as well.

Award of Credit. In these more successful programs, course credit was awarded either as transcript credit (institutional) or as credit that would apply toward degree. If degree credit was awarded, the basic skills course was considered an elective that fulfilled one of the degree requirements.

Flexible Completion Schedules. These institutions have some procedure whereby students can continue their basic skills course work into another academic semester or quarter without returning to the beginning of the skills cycle; that is, students re-enroll for the skills course, but their work for that semester begins where they left off in their prescribed work plan. While not nearly so common a practice, many colleges allowed students to enter the basic skills courses at any time during the semester, and many others would allow students to leave the courses with their earned grade any time during the academic semester/quarter. However, they did not allow students to continue indefinitely in basic skills courses, but rather they had some reasonable time frame in which the students were allowed to work toward achievement of their own skills goals.

Multiple Learning Systems. A variety of learning systems were evident in these programs. Students would work from prescriptions that were carefully written after the initial assessments were completed, they were involved in learning activities that were based upon clearly-drawn performance requirements, they were using self-paced modules as well as being engaged in group instruction, and they were using pre- and post-tests to move through their prescribed work. Instructors were not using the lecture method as the primary mode of instruction, nor were they relying primarily on self-paced modules--both instructional extremes proving ineffective with these students. Rather, they would have a varied number of strategies available in any class period to keep student interest high and to accommodate the diverse learning styles that were represented in these classes.

Monitoring Student Behaviors. Students are not merely enrolled in these basic skill courses; they are assigned specific work that is carefully monitored-- often on a daily basis. There was frequent use of peer tutors who had been trained to work with low-achieving students and were evaluated regularly themselves; these tutors allowed the instructor time to move more freely around the class as well as provided students with more individual attention during class sessions and in regularly-scheduled blocks of time outside of the class meetings. Intervention strategies were common when student problems surfaced--e.g., excessive absences, failure to produce assigned work, failure to meet acceptable standards of performance. Some of these intervention strategies required teachers or peer tutors to call students with assignments or assignment updates, to encourage them to return to class, and to schedule tutoring time or additional work to help them return to their work schedule with as little disruption as possible.

Volunteer Teachers. These courses were taught by instructors who volunteered to teach the basic skills students. They had met carefully predetermined instructional criteria; however, in the final analysis, they had made the decision to teach low-achieving students. Most developmental skills faculty are full-time in their disciplines and teach regular academic and skills courses during the same academic calendar. They receive staff development training in working with low-achieving students; typically, as well, their classroom performance is evaluated by students and administrators.

Interfacing with Subsequent Courses. Administrators and instructors of these courses assessed the reading, writing, and math requirements/demands that subsequent courses make on their students; and they designed course content and strategies around these findings. These modified needs assessments identify generic and specific skills. Frequently, assessed needs are formalized and written as exit criteria for the basic skills courses.

Program Evaluation. While most of the responding institutions acknowledged the importance of program evaluation, few had any procedures that automatically and routinely gathered the kind of retention data that we sought. They did, however, include in their plans for the future, the intent to develop improved retention strategies and assess their effectiveness. When evaluation data were collected, they were woefully inadequate to describe the outcomes of institutional efforts to respond to these students; furthermore, as was mentioned earlier, the data that were collected typically described basic skills completion and not student success in subsequent academic work. Student success in subsequent work is the crucial test of the basic skills program; it is this data that provides the best evidence about program effectiveness.

Many of these institutions described tangential outcomes of plans for improving data collection procedures--efforts to research, plan, and implement procedures whereby students could be retained longer and with more success; improved pre-assessment strategies to identify low-achieving students prior to their enrollment in any courses; improved intervention strategies during the first semesters to identify and provide appropriate counseling/ tutoring to potential drop-outs; improved interfacing with subsequent courses for improved curriculum and instructional development; and a design of discriminating exit interview procedures aimed at identifying problem areas for those students who are not successful in basic skills courses or subsequent academic work.

So Where Are We Now?

Rumors of this general instructional distress over great classroom diversity comes from all colleges and universities alike. There appears to be nothing on the horizon which suggests the situation will change any time soon. While standardized test scores are improving slightly and there are reports that students in many public junior high and high schools, colleges, and universities are being challenged to accomplish higher levels of work, there are other specifics that are frightening. For example, in 1981, the National Assessment of Education Progress (from the Office of Education) discovered that the average high school student spent less than two hours a week on homework. The last week of November, 1984, our Austin American Statesman reported on a recent release of Census Bureau information (reporting on an annual survey of school enrollment); data indicated that the median time spent on homework for elementary and high school children was 5.4 hours per week or one hour and five minutes each school day. The study also reported 12.8% of the students said that they never had any homework at all! Time on task is still woefully underrated--if these are accurate figures!

Since 1970, American high school students have been demonstrating declining skill levels--e.g., the average reading level has declined from tenth grade in 1970 to slightly below eighth grade this last year--a national average! The average high school grade has increased from a C to a B+--in spite of the accompanying evidence that skill levels have not increased as well. What this means to colleges and universities is obvious!

The University of Texas is a selective university, yet it serves more than 8,000 students each semester in its skill development lab. Richard Lanham, a UCLA Writing Program Director, writes:

> From 40 to 60% of approximately 4,000 entering UCLA freshmen--the top 12% of all California high school students--currently fail the English Proficiency Examination.
>
> Basic skills are the University's business right now because our

> students don't possess them. College students read and write like high school sophomores, law students (if you are lucky) like freshmen, and a high school principal crows with glee when his graduating seniors read at ninth grade level ("UCLA vs. The Literacy Crisis," The UCLA Monthly, published by the UCLA Alumni Association, April, 1982.)

In 1981-82, the state of Georgia spent more than $6,000,000 on developmental studies in 33 public colleges and universities; Ohio reports that it spent between 10 and 12 million dollars on its colleges' remedial program (Time, p. 72). More recently, October, 1984, a report, The Evaluation of Remedial Programs, Courses, and Services in California Community Colleges, was released. It included these figures from the California Postsecondary Education Commission report (Promises to Keep: Remedial Education in California's Public Colleges and Universities--CPEC, 1983): 45% of the enrollment in English is now what colleges define as remedial reading and writing; remediation in community colleges in 1980 and 1981 cost 66 million dollars. But California is fighting back. This latest report features data from present models of program evaluation, summaries of findings, and reports of on-going studies (completion dates, names and addresses of researchers included).

Our national consortium of community colleges, the National Institute for Staff and Organizational Development, provides us with daily feedback about what other colleges and universities are doing to better serve low-achieving students and to upgrade their entire college curriculum. For example, the City Colleges of Chicago--in an effort to lower their attrition rate, conducted their own research on the relationship between attendance and achievement. (You can guess what they discovered!) They printed the results of this research in clear, simple, succinct poster-type language and put these flyers all over the college for students and instructors to see (Easton). Instructors in Kentucky colleges are discovering successful instructional parallels between coaching football and teaching academics (Fisch). A community college dean of instruction in Oregon demands that the reading level of any textbook be included on the order form that is submitted to the bookstore--no level indicated, no order! Paired with knowledge of the reading level of the students in their classes, this information provides strong indicators to instructors as to the success students will have negotiating the text (Weber). Writing across the curriculum programs in Arizona use "collateral graders" to evaluate papers from all classes--regardless of discipline--by a standard measure and as one effort to monitor and improve the numbers and quality of written assignments across the college in all classes (Landsburg and Witt). These assignments are expanded to include essay tests--in lieu of multiple choice, fill-in-the-blank, and true-false tests that are the more common modes of evaluation these days. Reports of serious interest in active engagement with literacy issues are exciting!

But where we find ourselves now, generally, is--as we say in Texas--"between a rock and hard place." We may be opposed to teaching basic skills at the college and university levels (and these are not the places for it in the traditional sense), but we cannot hope to be out of this basic skills business anytime soon if we hope to stay in the business of providing traditional college-level instruction--if that instruction is characterized by the same high standards of literacy that we have come to expect and demand in the past. However, there is no need to reinvent the wheel if you are in the position of planning or implementing a basic skills program; models are ready and widely available--components of which may work very handily in your own institution. National surveys, such as the one we have recently completed--if regularly updated--should better assess the "state of the art" nationally and provide some benchmarks of skill development progress; national forums and conferences such as this one continue to be major support groups for sharing the design and implementation of instructional strategies for fighting the literacy problem.

Terry O'Banion, Executive Director of the League for Innovation in Community Colleges, recently wrote "Confessions of a Technologically Disabled

Person." In it he describes his early childhood in southern Florida and memories he has of going over to his grandfather's house every Saturday night and listening to the Grand Ole Opry on the battery-powered radio. He was not certain how the radio worked--or how they were able to get all of the stars in that little box--but he sure enjoyed hearing Ernest Tubb sing "I'm Walking the Floor Over You." He confesses that perhaps his grandfather didn't understand the workings of that radio either because he never threw away any of the batteries when they wore out; he just threw them over into the corner of the smokehouse. Terry recalls how, one long hot summer afternoon as a seven-year-old boy with a very rich imagination, he laid on the smokehouse floor, poking away with a stick at the large pile of rusting batteries, trying to prod ol' Ernest into singing one more "I'm Walking the Floor Over You."

I sometimes feel that we educators have been poking away at some rusty old batteries ourselves, making assumptions about how we ought to teach the basic skills and to what ends. But we just can't afford that luxury anymore! Luckily, we live in good times for sound curriculum development--we have presses both inside and outside our institutions to improve our services (and some of those pressures are not very comfortable, and they are frequently made by people outside of the educational institutions). But they are good presses; they will cause us to re-evaluate ourselves and our profession and our performance! We have a growing body of research that identifies successful strategies and models for effective courses and programs. We have resources outside of the educational enterprise; Pat Cross suggests that we all re-read the Peters-Waterman book on excellent companies--companies that strive to make winners out of ordinary people and _do_! The parallels to education are dramatic! I would commend our latest national study to you as an excellent resource for program planning. Finally, I would urge you to forget any lingering ideas that you may still be harboring that your institution simply does not have a literacy problem. In fact, I would urge you to seek out the answers you may have to those lingering questions about the size of that problem--it does exist! If you are currently into implementing basic skill programs, I commend you and hope that some of these aforementioned resources will be helpful. In any event, it is good to be with an audience of individuals who are choosing to be part of the solution and not a part of the problem. Much good luck to you!

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Bibliography

Ad Hoc Committee on Evaluation of Remedial Programs. *The Evaluation of Remedial Programs, Courses, and Services in California Community Colleges*. Sacramento City College, CA, October, 1984.

Austin American Statesman, "Homework is averaged at hour a day," November 29, 1984.

Easton, John Q., "Attendance and Achievement," *Innovation Abstracts*, Vol. VI, No. 30, November 2, 1984.

Fisch, Linc, "Coaching Mathematics and Other Academic Sports," *Innovation Abstracts*, Vol. VI, NO. 23, September 14, 1984.

Landsburg, David and Stanley Witt, "Writing Across the Curriculum: One Small Step," *Innovation Abstracts*, Vol. VI, No. 13, April 20, 1984.

Maxwell, Martha. *Improving Student Learning Skills*. San Francisco: Jossey-Bass, 1979.

O'Banion, Terry, "Confessions of a Technologically Disabled Person," *Innovation Abstracts*, Vol. VI, No. 21, August 17, 1984.

Richardson, R.C., Jr. and K. J. Martens. *A Report on Literacy Development in Community Colleges*. Washington, D.C.: National Institute of Education, 1982.

Roueche, John E. *Salvage, Redirection, or Custody? Remedial Education in the Community Junior College*. Washington, D.C.: American Association of Community and Junior Colleges, 1968.

Roueche, John E., "Between a Rock and a Hard Place," *Community and Junior College*, April, 1984, pp. 21-24.

Roueche, John E., George A. Baker, and Suanne D. Roueche. *College Responses to Low-Achieving Students: A National Study*. Florida: HBJ Media Systems Corporation, 1984.

Roueche, John E. and Wade Kirk. *Catching Up: Remedial Education*. San Francisco: Jossey-Bass, 1973.

Roueche, John E. and Jerry J. Snow. *Overcoming Learning Problems*. San Francisco: Jossey-Bass, 1977.

Roueche, Suanne D., "Elements of Program Success: Report of a National Study," *New Directions for College Learning Assistance: A New Look at Successful Programs*, No.11, March, 1983.

Roueche, Suanne D. and Veronica Nora Comstock. *A Report on Theory and Method for the Study of Literacy Development in Community Colleges*. Technical Report NIE-400-78-0600. Austin, Texas: Program in Community College Education, The University of Texas at Austin, November, 1981.

Roueche, Suanne D. and John E. Roueche, "Literacy Development: Foundation for General Education," New Directions for Community Colleges: General Education in Two-Year Colleges, No. 40, December, 1982.

Time, "Toughening Up on Admissions," January 11, 1982.

Weber, John, "Do Sweat the Small Stuff," Innovation Abstracts, Vol. VI, No. 28, October 19, 1984.

BIOGRAPHY - SUANNE D. ROUECHE

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Dr. Roueche has held a variety of positions at the Austin campus which have included the following: Director, Community College Teaching Internship Program; Director of a NIE project; and Lecturer in Educational Administration.

In 1979, Dr. Roueche was named Kentucky Colonel by Governor Julian Carrol and the Kentucky Legislature for contributions to Kentucky higher education.

Dr. Roueche's most recent publications have included "Studying Attrition by Studying Probation," *Innovation Abstracts*, Vol. V, No. 34, The University of Texas at Austin, Nov. 18, 1983; and (with John E. Roueche and George A. Baker), *College Responses to Low-Achieving Students: A Report on a National Survey*, N.Y.: Media Systems, Inc., 1984.

DEVELOPING BASIC SKILLS AT NEW MEXICO STATE UNIVERSITY

by

Gary B. Donart

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DEVELOPING BASIC SKILLS AT NEW MEXICO STATE UNIVERSITY

GARY B. DONART

In response to the presentation given by Dr. Roueche, I would like to reflect on some personal feelings and impressions developed from conversations with fellow faculty members. Remedial education at New Mexico State University is a new effort. Not counting the Drop In Laboratory, which is designed primarily to assist those with minimal educational deficiencies, and programs such as COPE, remedial coursework has been in effect for about six years.

At the time the remedial requirements were implemented, I advised few freshmen students. Only a small percentage of the freshmen were remedial by the established standards. A great majority of the faculty on this campus did not advise freshmen and were not really aware of what was happening. Memoranda were distributed to advisors explaining the remedial standards. With the issuance of the memoranda, one assumed administrative support as the criteria were implemented and printed in the catalog. Most faculty were still basically unaware of the criteria, the rational, or the extent of the problem.

During the past few years I have worked with a greater number of entering freshmen and a larger percentage of them were falling into the remedial category. Of great concern was the fact that many of the students had no idea that they were remedial in any area. They had done reasonably well in mathematics and English during high school. They would admit that they hadn't taken all the mathematics available to them but that was because they weren't interested in further mathematics at the time. They were confident that since they had graduated from high school that they could successfully pass a college level class. Have you ever tried to tactfully discuss a remediation problem with a high school graduate? These are students who have graduated from high school and have been told that they are capable of going on to the University!

During this same timeframe I had two children of my own who were preparing to enter college. Through observations of my two children, their academic performance and their ACT scores, I was able to obtain a much better perspective of the remedial student. While from a limited sample, I observed many students who chose a noncollege bound high school program, were in fact enrolling in college.

This was an era of rapid growth for the University. Student credit hour production was important and student recruitment was intensified. This is not to speak negatively to those efforts, but rather to indicate that this all occurred at the same time. As a result of the happenings, many of the faculty began voicing concerns regarding our remedial program. Concerns arose as to who had responsiblity for the remedial student. Should the University be involved in the teaching of remedial education? Should the high schools be forced to improve their level of instruction? This was a time of many "expert" opinions. Mathematics had gone from one remedial class to two. Proper placement was confusing for those who didn't follow the guidelines closely. Many faculty, possibly rightly so, didn't understand what was happening, or why. Legislation was introduced into the Faculty Senate on several occassions to "direct" the remedial programs. Finally legislation was introduced relating to reading competency. This would have resulted in a third autonomous remedial program! The Faculty Senate recognized the need for reading competency, in fact it felt that reading skills may be more limiting than mathematics or English for the entering freshman. Faculty Senate passage of the remedial reading request would have surely received administative acceptance.

From the Faculty Senate debates, bigger questions and problems arose. Who was to establish the maximum number of courses that a student would have to successfully complete to show that he had mastered the remedial skill. New Mexico State University is an open admissions campus. Page one of the General Catalog states that any student with a C average, or an ACT of 19 will be admitted. Further, on page two we also have a provisional program for New Mexico residents. On page 10 of the same catalog we have a brief, but incomplete, discussion of the Remedial-Basic Skills Requirements. Only by reading through the course requirements, the schedule of classes and the directions provided by the departments offering the remedial courses can you obtain a complete picture of the remedial skills requirement. Hopefully as an advisor you had access to a specially prepared and complete set of instructions.

More importantly we had a need to reassess our University policies, to improve our catalog, handbook and distribution statements. New Mexico State University did not want to be involved in recruiting students which it couldn't handle in the education process. This meant taking a hard look at our responsibilities. Should we recruit students with low ACT scores? Should we alter our entrance standards? In a state where financial resources are limited, the cost of remedial programs must be evaluated. It was interesting to note from Dr. Roueche that 50 percent of the entering freshmen at the University of California were enrolled in remedial writing, and that the state of California was spending $66 million on remediation in the community colleges during 1980-1981.

It was apparent we had to look at a total program evaluation. This included everything from counseling and placement to retention and success rate of remedial programs. How beneficial were our remedial courses in interfacing with subsequent coursework taken by the student. When 13 percent of the 1983-84 freshmen entered New Mexico state University with an ACT composite of 10 or less and 38 percent had an ACT composite of less than 16, we needed to know this information.

In the spring of 1983 the Faculty Senate elected to establish an ad hoc committee of eight to pursue these activities. The committee has prepared a preliminary report and is now ready to develop final recommendations for the Faculty Senate.

COMMENTS ON KEYNOTE ADDRESS GIVEN BY DR. SUANNE D. ROUECHE, "BASIC SKILLS: DEALING WITH DEFICIENCIES"

by

Betty Harris

New Mexico State University

Member: Basic Skills Panel

From Betty Harris,
Member,
Faculty Senate ad hoc Committee on Basic Skills

COMMENTS on Keynote Address given by Dr. Suanne D. Roueche, "Basic Skills: Dealing With Deficiencies"

I have three initial reactions to Dr. Roueche's presentation --

1. I am frightened by the statistics she presents regarding incoming student capabilities.
2. I am disheartened by the magnitude and universality of the problem of the underprepared college student in the mid-80's.
3. I am reassured that our problem at NMSU is a shared one -- and that the issue is being faced.

I also have questions --

1. How do we apply Dr. Roueche's comments to what is going on here?
2. Do we have a responsibility - implied or stated - to the student who "pays his money" - does he just "take his chances?"

We have a few facts to deal with at NMSU:

1. We are a land-grant institution, with a fairly "open" admission policy.
2. Some students enter NMSU obviously unready for college-level work.
3. Some of these students are unprepared by virtue of poor high school preparation, either school-fault or learner-fault.
4. Some students are unmotivated for personal reasons.
5. All students come to college for something.

-----Do we owe these students anything if we recognize, in advance, a strong potential for failure in college level work?

Your Faculty Senate appointed an ad hoc committee to study basic skills, and this committee has been working for a year and a half. We have studied what is already in place here. We have studied what is available elsewhere. The committee has discussed at length what "seems right" in the NMSU setting. And the committee has identified what we think we do want:

1. a diagnostic workup of students "at risk",
2. special counseling and advising for these students,
3. a mandatory course sequence based on diagnosed needs,
4. co-ordinated, strong program leadership, and
5. efficient use of current courses and faculty.

We have also identified some things we don't want:

1. clumsy, expensive program administration, and
2. a "class" system which might develop if we adopted the "general college" concept.

The Committee's work is incomplete. There is still much to be done here if the faculty decides we should meet the challenge of the student deficient in Basic Skills.

THE BASIC SKILLS PROGRAM AT NEW MEXICO STATE UNIVERSITY

by

James Nordyke

New Mexico State University

Member: Basic Skills Panel

THE BASIC SKILLS PROGRAM AT NEW MEXICO STATE UNIVERSITY

The Character of the Present Basic Skills Program

It should be noted that NMSU has had a basic skills program at least since the late 1970s. Two subjects are included in it. These two are English and Mathematics. The rule at NMSU is that, before a student may take any upper-division courses, the student must have demonstrated competence in these two subjects.

In English, competence is demonstrated by having an ACT score of at least 26 in English or by taking English 111: Freshman Composition, a four-credit course, and getting at least a C in it. In order to qualify for English 111, some poorly prepared students are required to take English courses lower than 111: these are English 100N: Writing Tutorial and English 102N: Basic Writing. Each of these courses are two credits each, but the credits do not count toward a degree.

In mathematics, competence is demonstrated by an ACT score of 22 in mathematics or by taking with a C or better Mathematics 102N: Basic Algebra, a three-credit course whose credit does not count toward a degree. Very poorly prepared students may have to take another more basic course first: Mathematics 100N: Arithmetic and Basic Algebra, also a three-credit course which carries no credit toward a degree.

Judging the Basic Skills Program by Standard Criteria

Dr. Suanne Roueche has described 11 elements of a successful basic skills program for U.S. colleges and universities. A successful program is one that retains a high percentage of students.

One of these 11 elements is strong administrative support. Evidence of this support consists in part of statement in catalogs and other written materials which stress the university's commitment to assess and place students in basic skills and to assist the student to achieve basic skills. By such a criteria, NMSU does not seem to have strong administrative support for basic skills. The NMSU requirements regarding basic skills are tucked away in several obscure and scattered places in the catalog and appear as rules to be imposed on students, without any supporting rationale or stated commitment by the university to help students achieve the skills.

A second element is mandatory assessment and placement of all entering students. Students are expected to enroll in required skill courses before they enroll in any regular non-skill course which uses the skills. NMSU rules fail in meeting this criterion. All NMSU requires is that the basic skill competencies be established before taking any upper-division course. NMSU rules permit a student to take many lower-division courses without the student's having demonstrated competence in relevant basic skills.

A third element of success is structured courses. Basic skills courses must meet at specified times, be a semester in length, and be graded. NMSU seems to meet this criterion of success.

A fourth element of success is award of credit for basic skills courses. NMSU's program seems to meet this criterion.

A fifth element is flexible completion strategies: students may exit from a completed course before the end or after the end of the semester in which enrollment in the course first occurs, but within clearly specified time limits beyond that. NMSU seems to meet this criterion.

A sixth element is multiple learning systems: both class work and self-paced work are mingled. NMSU may meet this criterion, but perhaps not fully in self-paced mathematics courses.

A seventh element is volunteer instructors and advisors, who are given some special training to handle basic skills courses and students. I do not know how well NMSU fits this criterion. General over-all counseling of poorly prepared students seems weak at NMSU.

An eighth element is use of students as tutors in basic skills courses. NMSU uses student proctors in the mathematics program, but the university could probably go farther in this respect than it has.

A ninth element is monitoring of student behavior in basic skill courses. This seems to mean keeping track of student absences and of failures to turn in good assigned work and calling the student who is excessively absent or who does poor work. I am not sure how much of this is done in NMSU's program, but I suspect the actual amount is rather too little.

A tenth element is interconnection between basic skill courses and regular courses where the basic skills are used. How much of this is done at NMSU is not known to me, but probably it is little. It is done in the special tutorial course University 101, but this course is not part of the program in basic skills.

Program evaluation is the eleventh element. This means carrying out studies to determine the degree of retention of students in basic skills courses and retention of students in the university after the completion of basic skills courses. Studies of retention in basic skills courses are done at NMSU, but there are no studies of the extent to which basic skills courses increase the retention of students in the university.

Recommendations for Improvement in Basic Skills

The NMSU program in basic skills could be substantially improved in the following ways:

1. By requiring deficient students to take their basic skills courses first, upon entering the university and before taking most regular lower-division courses.
2. By requiring deficient students to demonstrate competence in reading.
3. By requiring deficient students to take a tutorial skills course in conjunction with at least one of several designated regular freshman courses.
4. By having a special advising and counseling program for all deficient students, a program coordinated across colleges so that it is university-wide.
5. By having a sufficient number of basic skills courses and specially designated regular courses so that deficient entering freshmen can have up to a full year of such work before taking a regular curriculum.
6. By designation of a university-wide staff person to coordinate the assessment, placement, and advisement of deficient students, to encourage students and faculty to make the basic skills program work better, and to study the effectiveness of the program and recommend changes in it.

Conclusion

It seems to me that at present New Mexico State University does not have an integrated, coherent, comprehensive program in basic skills. It has a set of courses in basic English and another in basic mathematics. Within themselves these two sets of courses probably are well run, for the most part. But there is no general university program of a systematic sort for guiding and assisting deficient entering students. Such a program is needed. Otherwise the university will continue to lose these students through high attrition rates, and it may, with its policy of open admissions, eventually even become liable to the accusation of having lured them here in the first place under false pretenses.

IS HIGHER EDUCATION AN EDUCATIONAL PROCESS OR SCREENING PROCESS?

by

Martin Blake

New Mexico State University

Is Higher Education an Educational Process or Screening Process?

By Martin Blake

In the past few years, the American people have become increasingly concerned about the issue of basic skills. This concern is reflected in the numerous magazine and newspaper articles on this topic which have appeared recently in the popular press. One common misconception is that the basic skill problem is a new one. This is definitely not the case. As early as 1828, the *Yale Report* called for an end to the admission of students with "defective preparation." Other sources also indicate that nineteenth century American colleges and universities admitted students considered to be far below acceptable college level standards (Brier, p. 2).

What is the nature of this problem that has afflicted our institutions of higher learning for almost 200 years? There are two elements to this problem, one a student element and the other a faculty element. To address the student element of the basic skills problem, we must first clarify what we mean by basic skills. In a progress report submitted to the NMSU Faculty Senate on May 1, 1984, the Ad Hoc Committee on Basic Skills characterized basic skills as the ability "to write, calculate, think, read with comprehension, and, generally, to operate effectively in the university." The problem is not that some students are totally lacking one or more of these skills. The problem is that they do not possess one or more of these skills to the degree assumed by professors in the university who teach freshman courses. Such assumptions about entry skill levels are a necessity in the absence of proper data about entering students.

The student element of the basic skills problem is that students are individuals who have varying degrees of proficiency in what have been identified as the basic skills. When their proficiency in these areas is measured against the prerequisite skills assumed by professors in their courses, some of the students are judged to be insufficiently prepared or lacking the basic skills. Thus, one of the key elements of the basic skills problem is that professors' assumption about students' skill levels are not tested before the course but are judged after the fact. There is no diagnosis before entry into a course which could be used to determine if a student were improperly placed.

The faculty element of the basic skills problem is that many professors have not mastered the basic skills of teaching. They have not clearly defined the objectives in their courses or the prerequisite skills which students need to attain these objectives successfully. Most professors would be hard pressed to articulate the skills they implicitly assume that students in their courses possess. Many professors lack the ability to properly motivate students or effectively organize a lecture and have not mastered the basic classroom techniques of holding students' attention during a presentation. Lacking some of the basic teaching skills, they present their material to the students to the best of their ability and those students who do not succeed are viewed as lacking the basic skills.

When you get to the bottom line, the basic skills problem boils down to an educational organization which is insufficiently flexible to meet the needs of its clientele. If we were truly concerned about educating students, we would concentrate our efforts more on diagnosing a student's current level of attainment, prescribing a course of study to raise the student's skills to some desired level and effectively carrying out this prescription. In reality, our institutions of higher education more closely resemble screening processes. A screening process evaluates students' abilities and elminates all those who fall below some given level. Through screening, we select a group of students who are sufficiently skilled and motivated that they can acquire knowledge in the manner in which we currently offer it. This approach is best typified by the often heard quote about "weeding out those who are not truly college material." Looking at some recent data, it seems as though we may be weeding a little heavy. To date, only 37 percent of the entering freshman class in 1976 have graduated from NMSU with baccalaureate degrees. The fact that we can effectively meet the needs of only four out of every ten students who turn to us should indicate that there is something drastically wrong with our system. In the past, our current failure rates were tolerated by society. However, with society's increasing need for skilled people, I doubt whether such failure rates will continue to be viewed as acceptable.

The first section of the 1984 Administrative Policies and Procedures of New Mexico State University deals with the missions, goals, and objectives of the university. It expresses a commitment to an open door policy and a belief that everyone has the right to those opportunities for personal growth which a broad education provides. It states that "the primary duty of the university is to educate. As the land grant institution of New Mexico, New Mexico State University is committed to serving the educational needs of a student body of various ages, interests, and cultural backgrounds." However, there is a large divergence between our stated mission and the way in which we actually operate. When we employ screening tactics, we are expressing our basic disagreement with the open door policy. We do not stand ready to accommodate the varying skill levels that students of different ages, interests, and cultural backgrounds present us.

If we are to behave ethically, we either need to change our mission to meet our actions or change our actions to meet our mission. If we decide to change our mission, we must set admissions standards which give reasonable assurance that all those who meet these standards have a good chance of successfully completing a baccalaureate degree program. However, since we are a land grant university and have a history of having an open admissions policy, we may find it difficult to change our mission.

The other alternative is to change our actions to meet our mission. Since the basic skills problem contains both student and faculty elements, so must the solution. To address the student element of the basic skills problem, we must do a better job of evaluating students' skill levels when they enter, prescribing programs of study and carrying out the prescription.

We currently do almost no diagnostic testing of new students. The ACT test, which is required of all entering students, is not designed to diagnose learning difficulties. Although it may give some indication of a student's potential success in college, it does not permit the identification of basic skills deficiencies. All entering students are also given a mathematics placement examination. This test is designed to evaluate a student's level of attainment in this basic skills area.

There are no other tests which are currently administered to all entering freshmen to diagnose level of attainment in basic skills areas.

A university with an open door policy must be prepared to meet the needs of all students it admits. If a university has committed itself to a policy of open admissions, it incurs an obligation to conduct diagnostic testing for proper placement. Tests to diagnose a student's level of attainment in the basic skills areas are available. I recommend that we implement a comprehensive program of diagnostic testing for entering students if we are truly serious about educating them. We need to identify their level of attainment in the various basic skills areas and to identify areas in which serious deficiencies exist. We also need to identify the learning modes which are most effective for each of these individuals.

The next step is to prescribe a program of study to take the student from his current level of attainment to some desired skill level. This usually takes place through a student working with his advisor. In our current system, both the student and the advisor are handicapped in making this prescription. Typical college catalogs contain course descriptions so brief that they are unusable. In most cases, the student gets little idea of the skills and knowledges which can be obtained from a course by reading the course description. Prerequisites are stated in terms of courses rather than in terms of skills. Sometimes, there are hidden prerequisites where no prerequisites are listed in the course description, yet the teacher requires certain prerequisites on the first day of class. Freshman classes usually have no listed prerequisites. Yet, it is clear from listening to the professors who teach these freshman level courses that they expect the students to have certain skills.

Is it any wonder that students often end up in classes for which they are not adequately prepared, given the current state of affairs?

To help assure that students are properly placed, I recommend that we prepare detailed information about course content and the prerequisite skills necessary for success and get it into the hands of those who prescribe student programs. Although it may be too costly to include this detailed information in college bulletins sent to potential students for recruiting purposes, it is essential to make it available to advisors and others involved in student program planning. I also recommend that we institute workshops for academic advisors. These workshops would acquaint advisors with various techniques for using detailed diagnostic information in planning students' programs and with the resources currently available at the university which could be brought to bear on program planning .

Carrying out the prescription brings us to the faculty element of the basic skills problem. While obtaining their Ph.D.'s, most faculty are trained as researchers. Although some have experiences as teaching assistants, they are never really taught how to teach. When universities hire new Ph.D.'s after they have graduated, they neither check to see if this brand new teacher has the basic skills needed in teaching nor provide any training in these skills. Is it any wonder that many of our faculty are lacking some of the basic skills they need to effectively communicate the information which they have spent so long acquiring?

To correct this faculty element of the basic skills problem, universities need to invest more in their human capital. Most successful companies spend millions of dollars in training and upgrading the skills of their labor force. Universities spend almost nothing. We need to institute an ongoing program to upgrade the teaching skills of faculty. A once-a-year effort to improve teaching such as the one in which we are involved today will simply not do the job. It is like working out in a gym once a year and expecting to see improvement. The way to improve teaching skills is no secret. The skills needed in teaching can be improved in the same way as any other physical skill; namely, through practice and good coaching.

You do not become a good golfer by listening to people talk about golf. You try a few swings with a good coach watching you. The coach makes suggestions on how to improve your swing and you attempt to make these adjustments. After some practice, the coach observes you again and makes further suggestions. This routine of observation, correction, and practice continues until you really have your swing grooved.

To improve our teaching skills, we need to embark on a similar routine of observation, correction, and practice. First, we need to get trained evaluators to observe our teaching. These evaluators would make suggestions about how we might improve, and we would try to incorporate these suggestions into our teaching style. After a period of practice, we would be evaluated again. This routine would need to be an ongoing process which was mandatory for all teachers.

This routine needs to be mandatory for several reasons. First, if it is mandatory, it is less threatening. Most people who enter teaching as a profession have at least a little hot dog in them and most are high achievers. When dealing with such people, egos often get in the way of admitting that help is needed and in seeking it out. If a program of upgrading teaching skills is mandatory, no one feels like they are being picked on when an evaluator shows up in the classroom and no one has to ask for help. Help is provided for all.

Second, it must be mandatory to reach those with the greatest need. Often those who need it the most do not participate in voluntary teaching improvement efforts. It is human nature to avoid activities in areas where you are not proficient.

Finally, the upgrading of teaching skills needs to be mandatory to serve as a quality control for the educational service which we are selling. If we forget that the business we are in is selling an educational service and let the quality of that service slip, we are in serious trouble as an institution.

Specifically, I recommend that an outstanding teacher be identified in each department and that those individuals be provided training and release time for ongoing teaching improvement activities within their departments. I also recommend that the teaching improvement activities of these individuals be coordinated by a central organization, such as the Center for Educational Development and Evaluation, which would also provide the needed training and resource information for these individuals. These outstanding teachers involved in teaching improvement activities would have the advantages of 1) being familiar with the faculty in the department, 2) having familiarity with the subject matter of those whose teaching techniques they are trying to improve, 3) being accessible, since they are housed within the departments, and 4) having a recognized mastery of the basic teaching skills they are trying to develop in others.

What I am suggesting would involve a significant restructuring of our current institution. More resources would have to be devoted to diagnostic testing of new students. It is likely that additional courses would be needed to provide developmental opportunities for those with basic skills deficiencies. It would take additional time and effort for teachers to more clearly describe the skills and knowledges that could be learned in their courses, and to clearly identify the prerequisite skills needed for success. With additional diagnostic information and additional detail in course descriptions, it would take longer for advisors to design student programs. Resources would need to be released in each department for teaching improvement activities.

Clearly, embarking on such a course of action would involve some costs. It is likely that resources would need to be realigned within the university. It may also be necessary to make a case to the legislature for additional resources. Faced with these problems, there is a strong urge to opt for the status quo. However, there are also significant benefits from this course of action. It would almost surely resolve some of our retention problems and would be a strong selling point in recruiting new students. Retention of a larger percentage of entering students would result in increased resources for the university, as would improved recruiting.

Making these changes would also result in a system which would better facilitate the entry of older students. Older students, like their younger counterparts, may have skill levels below those necessary for success in many college courses. A demonstrated ability to meet the needs of older students is essential if we are to tap this potentially large market.

Some might argue that it is not the business of colleges to provide remediation in the basic skills areas. They feel that this is more properly the job of the high schools. However, many students decide that they would like to go to college very late in their high school careers. They have already omitted courses from their high school programs which would provide some of the basic skills needed in college. Others may take more time to gain mastery in the basic skills areas and high schools are very tightly locked into a four-year program. For both of these reasons, Universities need to be prepared to remediate the basic skills deficiencies of entering students for the foreseeable future.

The basic skills problem is one that is not likely to go away. Our entering students will continue to have varying levels of attainment in the basic skills areas. These skill levels will provide a poor fit with the minimum skill levels currently assumed in most of our entry level courses. This is apparent in the low percentage of entering students who successfully complete our degree programs. If we refuse to make the necessary changes and still accept the money of those who have very little chance of success, we are behaving unethically. Although it will require considerable effort, we must make the institutional changes needed to accommodate the varying skill levels of those who we currently define as our clientele.

REFERENCES

Brier, Ellen. "Bridging the Academic Preparation Gap: An Historical View". Journal of Developmental Education, Fall, 1984, pp. 2-5.

A MODEL FOR THE DEVELOPMENT OF CONTENT-AREA BASIC SKILLS COURSES AND ITS IMPLEMENTATION AT A LIBERAL ARTS COLLEGE

by

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LaRoche College

A MODEL FOR THE DEVELOPMENT OF CONTENT-AREA BASIC SKILLS COURSES AND ITS IMPLEMENTATION AT A LIBERAL ARTS COLLEGE[1]

David E. Borrebach, Ph.D., Mark O. Farrell, Ph.D., and
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La Roche College

La Roche College is a small (FTE ´ 1000), regional liberal arts college in suburban Pittsburgh, PA. Over the past five years members of the faculty have systematically developed and pursued a model for the integration of basic skills development across the curriculum. This paper describes the model, including the techniques we have used, the results we have had, and what we have learned about the process.

The Beginning of the Basic Skills Program

The basic skills program developed as a direct result of faculty unrest concerning the unrefined nature of the the reading, writing, and computational skills of our students. Like many institutions, we had a group of students who were identified as being "at risk" in a college situation because of poor preparation (as shown by relatively low high school grades and low scholastic aptitude test scores). However, these students were few in number, and special "developmental education" program, (which was remedial in nature) had been put in place for them. But the problem with reading, writing, and computational skills seemed to exist across the student population, with students who had respectable grade point averages and class rankings in high school. Our students seemed to think that studying meant reading over textbook material twice, and many had trouble reading textbook material in any case. A number of students could not fashion complete sentences or coherent paragraphs, and they did not know how to convert fractions to decimals or perform other fundamental computations.

Faculty response to this problem was varied. A few tried to address skills development directly in their courses, but most avoided discussion of mathematics or reading, and adopted varying strategies with regard to writing. Some faculty simply discontinued giving writing assignments (particularly in the introductory courses), arguing that student papers were incomprehensible. Another response, which was somewhat more common, was to stress (and grade) only on the content-related elements of a student's written work. If a student wrote in an ungrammatical fashion with numerous misspellings, but had the content correct, the student received the same grade as someone with grammatically correct work and the same understanding of content. Students were thus neither penalized nor rewarded for their writing skills. And a third response was to make corrections to a student's work, and perhaps reduce a grade in response to grammatical and spelling errors, but not to otherwise address writing in the classroom, or to require that poorly written work be resubmitted.

Development of the Basic Skills Model

In the late 1970's the "basic skills problem" led us, as an institution, to develop a model to deal with the problem. Our model had three primary components: (1) the basic skills program would be developed by content-area faculty and integrated into content-area courses; (2) the program would be directed at freshmen during the first year, sophomores the next, and juniors and seniors during the third year; and (3) the program would stress the active involvement of both faculty and students. Faculty would deliberately structure modules for their courses which would in turn require the active involvement of students.

We sought and found funding for the project as part of a Title-III SDIP grant. The basic skills portion of these funds provided primarily for the administrative support of the program, for consultants, and for summer stipends for a group of faculty. While outside funding is not necessary, it obviously reduces the burden on the institution. In La Roche's situation, it made the program possible.

The Basic Skills Workshops

The involvement of content-area faculty in the basic skills program requires a time commitment few can make while teaching a normal course load during the regular semester. We therefore decided to hold a series of summer workshops for faculty during which the basic skills activities would take place. All faculty at the institution were given the opportunity to nominate themselves into the program.

The First Summer Workshop. Nine individuals were selected for the first workshop, which ran for six hours a day for six weeks. During this workshop the participants had three basic goals. The first was to discuss and define what basic skills would mean at La Roche College; the second was to learn about a number of techniques that could help students develop and enhance competency in basic skills; and the third was to apply the techniques in one or more modules that would subsequently be used in specific freshman-level courses.

Defining basic skills. We defined basic skills as the generalizable, fundamental skills necessary for success in college and in the world of work subsequent to college. These are skills that are largely independent of content, but which are necessary in any content area. We came to agree that basic skills are relative to a student's level in college--basic skills for a freshman go beyond what would be learned in the twelfth grade; basic skills for a college senior refine and extend skills that have been previously acquired.

The biggest problem that we have encountered with this definition is in the semantics. Many faculty equate basic skills with remedial skills; at La Roche we simply reiterated our definition until the entire faculty understood that remedial skills and basic skills were not the same. We also had some semantic trouble with the notion of upper-division basic skills; some faculty argue that anything done at the upper division is necessarily an advanced skill. The general response to this argument at La Roche is to defuse it by focusing on the kinds of activities prescribed in the upper division classroom.

Basic Skills in Content-Area Courses. We have occasionally heard it stated that the only thing that belongs in a content-area classroom is the specific content in the course, as if articulate writing or effective reading are unrelated to the course at hand. The faculty at the summer workshops spent a substantial amount of time discussing this issue, but the point eventually became moot for two reasons. One was the simple fact that as we thought about incorporating basic skills in our classrooms most of us found a technique which integrated basic skills into the content area so well that it would have been adopted even in the absence of a formal basic skills program. The second, related reason is that after the workshop faculty tried the basic skills modules during the first year of classes they worked so well that most of us began adapting the modules for use in number of our courses. As basic skills came to be integrated throughout the La Roche curriculum the argument against their incorporation in content area courses became increasingly infrequent.

The second and third workshops. During workshops held the second and third years participants worked on developing modules for sophomore, and then for junior and senior level courses. As in the first summer we used the help of consultants; we found that those who focused on specific "nuts and bolts" strategies for building basic skills competencies were most effective. By the end of the third summer workshop a sequence of courses was in place that provided opportunities for basic skill development across the curriculum.

Examples of Modules

What follow here are specific examples of how a basic skills component can be incorporated in content-area courses.

Introductory Psychology. One of the modules inserted into the Introductory Psychology class dealt with reading original published articles. After reading the article students are given a three-pronged writing assignment. They are first asked to summarize the article (in less than 150 words), then to discuss a specific aspect of the article in relation to the class discussion and text material, and subsequently to offer their own reasoned opinion on a controversial matter contained within the article. Students write a draft of their paper, and bring it to class for comments by fellow students and for a general classroom discussion of the topics associated with the paper. They then produce a final copy which is handed in during the following class period for grading on content, spelling, and grammar. While not all students avail themselves of the opportunity to improve their written work, most do, and there has been a clear improvement in the quality of written work produced.

General Biology. General Biology I and II is a two semester introductory course taken predominately by future biology majors. Specific attention was given to the problem of developing reading, writing, and mathematical skills without a significant dilution of content. The answer to this problem was to develop skills in different components of the course. The classroom component of the course is especially good for the development of reading skills, while the laboratory associated with the course is well suited for the development of writing and mathematical skills.

In order to develop reading skills without content-area dilution certain procedural changes were put into effect. The text used in the course took on increased importance. Lectures which previously ran parallel to reading assignments were more explicitly related to the reading assignments. At the time a reading assignment was given the instructor tried to anticipate possible areas of difficulty, and previewed them for students. During the next lecture portions of the reading assignment were referred to directly, particularly graphs and difficult paragraphs. Outside material and examples were still incorporated, of course, but the text and lecture presentation came to form a more cohesive whole.

In the laboratory the written report took on added importance when the basic skill module was inserted. Prior to the addition of the module primary emphasis was on grading content; subsequently the grade also reflected grammar, spelling, and the clarity of expression in the procedural parts of the report. This added emphasis was developmental, rather than punitive, in nature. Otherwise, only the academically strong students would survive, which is contrary to the philosophical underpinnings of the basic skills approach. To provide time and opportunity for academic development, reports were collected and returned on a weekly basis. Reports which were deficient on grammar and spelling could be rewritten and resubmitted for grading. Also, a weighted grading system was used, with later reports given a higher weight than earlier ones to promote a developmental approach.

Chemistry. Since 1980 a concerted effort has been made to integrate skill development components into key courses in chemistry at La Roche College. Three chemistry courses in particular have been targeted: General Chemistry I, Organic Chemistry I, and the Senior Seminar. Each has a unique aspect to its skill component based on the nature of the course and the range of students taking the course.

General Chemistry I is the introductory chemistry course and is taken by all natural science majors. This course is intended to present key concepts needed for upper division courses in biology, chemistry, and physics, and also to provide a general body of knowledge about what is often called inorganic chemistry. Because there is often a wide range of abilities in this course, a considerable amount of time is devoted to building skills in mathematics and laboratory technique. For this reason the skill development component was focused entirely on the laboratory portion of the course where the instructor can better deal with individual needs. The program uses the laboratory experience to build reading, writing, and mathematical skills. The laboratory report becomes the vehicle for skill assessment and consists of three portions. The first section is a "pre-lab" section in which the student must state the purpose of the experiment, list all equipment needed in order of use, and summarize the key procedures. This helps develop reading comprehension skills and writing skills. The second section is an "in-lab" portion which consists of recording observations and data on a report sheet.

The third section is a "post-lab" section in which the student completes all calculations and writes a summary of what he or she learned. This is quite challenging for the students at first, but after several labs they learn what is expected and become better able to summarize their learning. Each lab report is graded on a ten-point scale; each point represents a desired skill. These points are:

1) Correct calculations;
2) Correct use of significant figures;
3) Proper selection of formulas and equations;
4) Correct observations;
5) Accuracy and precision of measurement;
6) Correct spelling;
7) Correct sentence structure;
8) Correct paragraph structure;
9) Accurate summarization of the procedure; and
10) A coherent, cohesive statement of learning.

Each report is graded for each of the ten points. Specific written comments are made and often individual discussions are held. The students keep all of their reports in a folder and progress is checked each week. Special emphasis is given to skills which repeatedly show deficiencies, and often remedial work is advised in the college's Learning Center. These lab reports provide a weekly evaluation of skill development and also allow the instructor to profile a student's strengths and weaknesses. As it has evolved, the reports are good predictors of final course grades: students who perform well on the reports from the start generally earn an A or B overall; those who have low scores initially but raise them over the semester usually earn B grades, and those who start low and stay low most typically earn a D or F in the course.

The basic skills module for Organic Chemistry was developed during the faculty workshop in the second summer of the program. Organic chemistry is an upper division course taken by biology, chemistry, and medical technology majors. Large amounts of complex material must be mastered in this course, including 550 pages of difficult textbook material in 14 weeks. The skill development component thus concentrates on reading skills. On the first day of the course a Cloze exercise is performed to assess the students' ability to comprehend the text (see Vacca, 1981, pp. 270-273). All students are then instructed in two learning strategies, and those who score below a 40% cut-off score are also advised to seek additional help at the Learning Center. The first of the two learning strategies discussed in class is the SQ3R prereading/study strategy (see Robinson, 1970). The second strategy involves the use of structured overviews, in which key vocabulary terms are arranged in a hierarchical fashion (see Vacca, 1981). Initially students are given structured overviews with all key terms properly arranged. After the first four weeks certain key words are omitted, which requires the students to discover the missing words. Eventually no overviews are handed out and students are encouraged to do their own. The purpose of both the SQ3R and the structured overview is to teach students to help themselves.

The third chemistry course targeted for a basic skills component was the senior seminar, which must be taken by all chemistry majors. The major goals of the course are to have students read professional literature, write a review paper of beginning professional competency, and design an experiment. A technique used to carry out the first goal is to have students critically read, and then "translate" technical papers into their own words. For the review paper and the experimental design, the student consults with the instructor and develops an outline. Drafts are then written in a section-by-section manner. Each draft is submitted to the instructor, who suggests revisions and returns it to the student. Most students produce two drafts prior to reaching the final copy; some occassionally require more. The developmental approach ensures that each student masters the skills necessary for professional-level work.

The sum total of these courses is a comprehensive effort to build and maintain basic skills in our science students which extends over the career of a chemistry major.

The Integration of Basic Skills Across the Curriculum

Two primary forces worked to help spread basic skills courses throughout the La Roche curriculum. The first of these was the incorporation of modules taught by basic skills workshop faculty in courses other than those originally designated as basic skills courses; this effect was referred to above. The second force was the curriculum revision process in which La Roche was involved at the time. Two years after the first basic skills workshop the faculty as a whole voted to establish a structure for basic skills development across the curriculum. One component required all students to take a two-semester sequence of English composition courses, and a college-level mathematics course. At the same time basic skills courses were formally established as a part of the curriculum. Faculty in all academic divisions were required to identify a lower and an upper-level course as a course in which basic skills would be explicitly addressed. Students were not required to take any specified number of basic skills courses, the thought being that the sheer prevalence of basic skills courses across the curriculum would be sufficient. The results of this revision are still out, but faculty seem to agree that seniors seem more prepared now, while entering freshman still seem to have the same needs as our students did prior to the basic skills program. A newly established committee is now assessing the current basic skills courses and is developing guidelines for the formal evaluation of their success.

Recommendations

The experience of La Roche College with its basic skills program demonstrates that content area faculty can make a difference in their students' development of mathematical, written, and reading skills. While any curriculum revision involves both costs and benefits, those involved in the program agree that the benefits are substantial. The greatest cost comes not from the time spent in the classroom, but the time faculty spend outside the class in the evaluation of student work. The additional work is most noticable with the implementation of an entirely new assignment. If a basic skills module is integrated into an existing assignment (such as the writing of a paper), there is little additional time needed to attend to basic skills issues.

The biggest requirement in this case is simply to be intentional about the activity.

Another point we would like to stress was the benefit of having content-area faculty nominate themselves into the program. A core of interested faculty got the program rolling, and it was the interest and experience of the core group that facilitated the dissemination of basic skill courses across the curriculum.

The use of stipends for participation in summer workshops worked well; we have used this technique subsequently for curriculum revisions outside the basic skills area. Basic skills modules were developed under more relaxed circumstances than is possible during the academic year; there was more time to think and talk ideas over. Faculty benefitted too from the mutual sharing of ideas and sense of team spirit that developed during the workshops.

The basic skills program was conceived and developed by faculty. Workshop faculty had the opportunity to explore and discuss various possible structures, and to arrive at one which "fit" La Roche. Leadership came largely from within the faculty, and that leadership was based predominately on the personal power of knowledge and ideas rather than power derived from an officially appointed position. Our program clearly benefitted from this arrangement.

Our use of outside consultants had more checkered results. One of the distinguishing qualitities of a consultant is that individual's ability to extrapolate general educational principles to specific individual institutional needs and problems.

Note

1. We wish to give particular thanks to Dr. Mary Stuart, our Vice-President for Academic Affairs, Dr. William Hahn, now the Vice-President for Student Affairs, but previously the Director of the Title-III program and coordinator of the summer basic skills workshops, Dr. Kathleen Angel, C.D.P., currently on leave of absence from the college, who played a substantial role in the initial formulation of the basic skills model, and who served as the Basic Skills Coordinator during the first years of the project, and to our colleagues in the basic skills workshops.

References

Robinson, Francis P. (1970) *Effective study (4th ed.)*. New York: Harper and Row.

Vacca, Richard T. (1981) *Content area reading*. Boston: Little, Brown.

All of our consultants were not equally adept at this, and a number did not take the time to familiarize themselves with the workings and philosophy of the institution. The less effective consultants spent a relatively large amount of time lecturing to us on material which was not particularly relevant to our college or to our goal of fostering basic skill development. The better consultants seemed to have a better idea of our mission and were more able to help us acquire knowledge and skills. The same theme which we have come to emphasize when teaching students basic skills--give students the opportunity to produce--was applied to the workshop by effective consultants. The workshop faculty thus responded best when asked to do such things as construct their own hierarchical outline of a chapter, or to apply one of a set of writing strategies to their class material.

In any case, consultants came to play a less important role later in the workshops. The faculty developed and articulated a definition of what basic skills would be at La Roche, which reduced the need for outside stimulus. Also, we came to rely on each other's skills, having found that activities and ideas suggested by our own faculty easily had the merit of those suggested by consultants. Our own faculty also had the distinct advantage of knowing our situtation and our student body intimately.

In the future we would recommend that consultants be used, but somewhat sparingly. An outside consultant would be useful in facilitating the initial discussion of what basic skills involves, and consultants with specific skills can help provide exercises for content-classroom use.

LITERACY AND WRITING: MAKING THE 'CONNECTION'

by

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Literacy and Writing: Making "The Connection"

For those of us who teach basic English or any freshman composition course for that matter, statistics pointing to the low level of illiteracy in the United States, less than 1% of the total population, are far from comforting. The type of illiteracy quantified here is the most basic kind--the inability to read and write. This is obviously not the type of illiteracy we have in mind when in moments of exasperation, amid the piles of freshman papers we are grading, we are sometimes moved to lament the "illiteracy" of our students.

Critics today are divided on the definition of the term literacy. It is the sort of word that can easily be manipulated to accommodate the statistics, and the statistics can be merely interesting or disconcerting or frightening depending on how they translate into human beings that actually affect our daily lives. For example, the estimate most often used is that one out of every five adult Americans, approximately 23 million Americans, is functionally illiterate; i.e., these people lack the reading and writing skills to perform basic tasks in our society, such as read signs or fill out the ubiquitous forms which seem to have become a part of our lives. Twenty-three million is a figure that can be staggering. After all, who among us would not be happy to win one million dollars in a lottery? On the other hand, twenty-three million is a figure that becomes meaningless when compared to our country's national debt. Wouldn't President Reagan be pleased if he could chop 1.65 trillion down to 23 million dollars? But when we talk about literacy, we are not talking about dollars; we are talking about people. Some of the strongest advocates for literacy campaigns like to point out the dollar-and-cents effect of illiteracy; for example, it is estimated that 7 billion dollars is spent yearly to keep hundreds of thousands of illiterate prisoners in United States jails. At least another 6 billion dollars is spent yearly in the funding of welfare programs and in loss of productivity.[1] Still, unfulfilled or damaged lives do not translate into numbers very well.

So, long having been suspicious of the statistics and the scholarly articles and public debates on terms such as raw literacy, functional literacy, semi-literacy, pre-literacy, and even super literacy and yet believing that I, as a teacher of basic English, have something to do with all these statistics and terms, I turned to my students for answers and help. What this paper explores is what they told me and also what I learned from a book entitled *On Literacy: The Politics of the Word from Homer to the Age of Rock* written by Robert Pattison and published in 1982. Both my students and Pattison forced me to look at the troublesome word literacy and also at the elusive process of writing and examine more carefully the connection I believe to exist between the two.

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[1] Jonathan Kozol, *Prisoners of Silence: Breaking the Bonds of Adult Illiteracy in the United States* (New York: Continuum, 1980), pp. 2-3. This book by Kozol along with his *Children of the Revolution: A Yankee Teacher in the Cuban Schools* (New York: Delacorte Press, 1978) examines the connection between literacy and social policy.

First, a look at what my students have to say. In spring, 1984, I asked the students of my basic English classes at the University of Houston-Downtown, some forty-two students, to respond to the question "What is literacy?" Here are some of their undoctored replies:

1. The word literacy could have several different meanings. Of the several different meanings I personally have no idea of what it means. But I will try my best to define it for you. In my opinion, literacy deals with the process of learning.

2. I think literarcy has something to do with literature. Literarcy probably has something to do with some type of grammer, or maybe some form of literature. Literarcy would probably even deal with writing in a particular way.

3. I have always felt a little literate about things I do in life. So I think that literacy plays a major role in my life.

4. What is literacy I think that literacy has something to do with liter. For example Houstons literacy is growing more everyday. And will get worst in the oncoming years.

5. When in society people have sense of respect love and care for other I would call this as a leterate society. On the other hand, even if people are graduate from Cambridge University and if their acts are not like literate people then I would call them illeterate person or illitracy.

6. What is literacy? Literacy is the ability to read and write. There are standards that determine your literacy level. There is a movement in the country today to improve the level of the literacy of children in our schools.

When during the next class period, I asked the same question of these students, the responses remained relatively unchanged, suggesting that those who did not understand the term the previous class were not motivated to find out what literacy meant since their second response basically repeated their first. An interesting postscript to this exercise is the fact that the students providing responses 1, 2, 3, and 6 all passed English 1300 (Basic English) at the end of the semester. The writers of the fourth and fifth responses withdrew from the course before semester's end because of failing grades. For me, this pass/fail rate raises serious questions about the function of basic writing classes and their connection with the student's achievement of a certain level of literacy.

Surveying these same students, I decided to examine their attitudes toward writing and reading, commonly regarded as the two basic components that define one's standard of literacy. Not surprisingly, one student out of over forty enjoyed writing. The others rated it as an activity slightly less enjoyable than having their teeth pulled. When questioned about their dislike of writing, the students invariably replied that writing was too hard and that they saw little practical benefit for it in their future lives. This response was strongly held, in particular, by students in the technological disciplines. When asked to define the term writer, these students usually spoke of a professional writer, someone who writes well and who gets paid for her product. They also tended to see a writer as someone who can with ease translate her thoughts onto paper, and because these students lacked that ease, they saw its absence as one more indication that they were not writers. There is probably not a single English teacher alive who has not heard at least one of her students say, "I can talk a whole lot better than I write." Most of the time, this is not really true. The student neither speaks nor writes well, but without the "evidence" of the written word, the student is less easily made aware of her failed attempts at communication.

In this same survey, I also questioned my students as to their reading habits. The material most of them read was newspapers and magazines. The reason they most often read was for information. They continued to read a piece if it was interesting; they stopped reading if it was boring. When pressed as to what made something interesting, they cited qualities such as action, suspense, excitement, adventure--qualities not normally associated with informational reading--and a basic curiosity about the subject matter to begin with. The quality that most often made a piece boring to them was the difficulty of the writer's style or his choice of words. Students were unwilling to continue to read what was not immediately comprehensible to them. The catch-22 here is that most college-level reading is not readily comprehensible to a basic English student.

One of the most troubling responses to my survey came in answer to my question "What do you see as the role of reading and writing in your life?" Several left the answer space blank, and when I later followed up with questions as to why, each student replied that she had not understood the question. Other responses were also discouraging. Some students acknowledged that the role was one of importance but did not elaborate further. Other students spoke in terms of having to read and write class assignments in college and prepare reports of various kinds in anticipated careers. Both reading and writing were consistently seen in terms of practicality by the student, which may explain, at least in part, why these same students do not want to take courses in literature even while they can see some value in "writing" courses. Literature, after all, does not tell them how to be successful in life or how to get a better job, and for many basic students these are the prime reasons behind their going to college, sometimes the only reasons.

If reading and writing skills are the primary means of assessing literacy, then it makes sense that not only performance in these areas but also attitude toward developing competency in performance is important when we talk about literacy. The key word here is attitude. What defeats many basic English students before they enter the classroom is their attitude toward the job that awaits them. But it is not just their attitude that defeats them; it is ours, the one that we bring to the teaching of these students whose previous academic failures are, for the most part, failures we as students never suffered.

Robert Pattison's book On Literacy was useful for me in challenging some of my attitudes and in getting me to reconsider what literacy is and what my role as a writing instructor has to do with it. Pattison takes what many would call a radical stance. He dismisses a number of works on literacy as the "same old whine," which he sees characterized by faith in four axioms:

> 1. Literacy is equivalent to skill in reading and writing.
>
> 2. Individuals who are literate by this standard are more cultured and civilized than those who are not.
>
> 3. The skills of reading and writing should be propagated among poor people as a first step in their economic and social development.
>
> 4. The skills of reading and writing should be preserved and expanded at home as a chief means of protecting democracy, moral values, rational thought, and all we hold dear.[2]

In his book, Pattison amends each of these premises. His first amendment is particularly important because it sets forth a new definition of literacy, which Pattison sees as "foremost consciousness of the problems posed by language, and secondarily skill in the technologies, such as rhetoric and writing."[3] The people that Pattison takes to task are the John Simons, Edwin Newmans, and William Safires of our culture whom he sees arguing needlessly over word usage, "splitting hairs," and preventing, whether consciously or unconsciously, the natural evolution of the language. The extended example that Pattison gives of

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2. Robert Pattison, On Literacy: The Politics of the Word from Homer to the Age of Rock (New York: Oxford University Press, 1982), p. vi.

3. Pattison, p. vi.

such "counter-evolution" on our college campuses involves a professor at a Midwestern university who is preoccupied with the abuse of the English language as demonstrated in misuse of the word hopefully. I am not sure what this professor or Safire or Newman or Simon would make of my students' writing. Perhaps they would respond to it with horror. I do not have time to trouble over these "niceties of language," as Pattison puts it, because when a student writes of "french prevenshunal funiture" instead of French provincial furniture or when she writes of "radio tires" instead of radial tires, these are more than mere slips in language. They are indicative of far more serious problems in the student's writing and her understanding and usage of language.

However, what Pattison attacks, and I think rightly so, is the "cult of correct usage," that emphasis upon form frequently at the expense of substance that prevents us from dealing with the more important problems that confront us: while some can't read or write, others can't speak English, and few can think.[4] A brief look at recent "basic writing" texts shows books that stress grammar and sometimes paragraph development. Do these books work for my students, 99% of whom are minority students, usually of Hispanic or Black backgrounds? The answer is a resounding NO. And the attempt of textbook writers to recognize minority interests by incorporating Hispanic or Black names into grammar exercises does not help the situation. Eight-word sentences that read "José and Maria

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[4] Pattison, p. 157.

(go, goes) to the film together" do not suddenly provoke the interest of my Hispanic students in correcting long-standing problems in subject/verb disagreement. What most basic writing texts do is alienate their target audience, most of whom have managed throughout twelve years or more of schooling to resist learning what these texts are once again trying to teach them. Why the resistance? One good reason is that most of these students fail to see the utility of learning the difference between a gerund and a participial phrase at age eleven or sixteen or twenty. Another good reason is that grammar drills reinforce the students' sense of inadequacy when it comes to writing. Students become so intimidated by the threat of doing something wrong grammatically that their thoughts and their pens freeze in mid-sentence. I am not saying that grammar should be ignored in basic writing classes, but rather that it needs to take a definitely subordinate role to the process of writing itself, which is more than an exercise in putting the commas in the right place. It always amazes me how many students are worried about commas. My experience shows me that while grammar exercises and drills can help improve the grammar of some students on subsequent grammar tests, these exercises and drills do not, in and of themselves, make students better writers or more literate writers. Yet each year, major publishing houses produce new texts for basic writers, which, in their prescriptive approach, continue to fail our students' needs. What we need are not more textbooks, but a different attitude and approach to the teaching of basic English.

Near the end of his book, Pattison makes three general suggestions about teaching English that I think are worth consideration in the revamping of our freshman English programs. First, he suggests that standard English be taught as a "practical tool of social advantage." What Pattison objects to is the argument advanced by some that "the survival of American civilization rests upon the univeral dissemination of reading and writing."[5] For example, a recent article in the *Houston Post* was captioned "Report: Illiteracy a menace to nation." The article went on to quote historian Daniel Boorstin, head of the Library of Congress, who in a report to Congress stated that the best way to observe the 200th anniversary of the Constitution in 1989 would be to make the country a nation of readers and to "justify the faith that a free people can provide themselves and their children with the knowledge which will keep them free!"[6] Pattison's point is that mechnaical literacy does not ensure the development of a critical mind nor a citizen's making the right choices to maintain a democracy. What mechanical literacy does promote is the efficient transfer of information in what has become an information-oriented society. My students respond most positively to the demands of learning standard English not when they are told that somehow this knowledge helps promote democracy, but when they understand that their ability to use standard English affects their worth in the market place. When they are made to see that prospective employers do, in fact, make value judgments on their job aptitude based upon their ability to correctly fill out an employment application form, these students become more serious about their English. What basic writing students need is to hear from someone other than English teachers that standard English is important.

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[5] Pattison, p. 172.

[6] "Report: Illiteracy a menace to nation," *Houston Post*, 15 Dec. 1984, sect. 1, p. 3.

Pattison's second suggestion for the teaching of standard English is that it should be treated as a second language, and not as the correct form of the language that the student already writes and speaks. I remember counseling a Black student last semester who was having tremendous problems in writing about literature. She listened patiently to my critique of her work and then smiled and said that she was going to have to take the advice of her friend who had told her basically to ignore her own writing voice and write the way white people talked because that's what they wanted and expected. She saw standard English much the same way that I might see my Sunday best, something to be taken out and used as the occasion demanded, but something which was not a daily part of her life nor which she was necessarily comfortable with. She recognized the difference between the way she spoke and wrote and the way I did, but to her the difference translated into inequality with one type of English, standard English, maintaining its ascendancy because it is the language of the prevailing middle class.

Similarly, midway through last semester in one of my basic English classes, as I was explaining subject/verb agreement, stressing the "s" ending in third person singular present tense, a hand shot up in the back of the room, and a student innocently asked, "Are you sure that the answer is 'she walks' and not 'she walk?' It just don't sound right." And, of course, to her it didn't sound right. It was a speech pattern foreign to her own.

The resolution "The Students' Right to Their Own Language," passed in 1974 at the national convention of the Conference on College Composition and Communication, calls among other things for teachers to respect the language spoken by minority youth in their homes and neighborhoods. The third sentence of the resolution says, "The claim that any one dialect is unacceptable amounts to an attempt of one social group to exert its dominance over another." Spoken/written variations and other language awareness are written into the goals of the current UH-Downtown freshman English program, but even as I try to meet these goals, both my students and I recognize that my respect for their dialect cannot guarantee the same respect for it in the business and scientific communities, and so we work together to achieve still another stated goal of the UH-Downtown writing program, and that is attainment of the "ability to use language which observes the conventions of standard written English."

However, the problems of minority students attempting to write standard English are further complicated by the fact that many of them do not speak it and are literally translating from their dialect as they write. But they are translating into a language that they don't totally understand, a language which is for them a pastiche of what they have heard from their teachers over the years and from the media, and so post-Watergate gobbledygook is peppered in among the most basic kinds of grammar and spelling errors. Vocabulary words memorized from lists in high school English classes are introduced into sentences where they are laughably inappropriate; e.g., "We went to a party Saturday nite. Their was great music and food. All in all, we had s supercilious time!" These students are striving for an effect, concentrating on form rather than substance, which brings me to Pattison's third and final suggestion for the teaching of English.

Pattison believes that "students should be encouraged to think, speak, and write according to their own conceptions of literacy." This may sound like a call to chaos, but what Pattison wants to stress is the student's development of her own writing voice. He adds these caveats: the student must understand

> that society at large will not accept ideas written in this form; that the speech and writing must be clear and comprehensible according to its own standards; that the student should develop his awareness of the uses of language as a result of his own writing.[7]

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7. Pattison, p. 168.

You might question exactly what, with all these warnings, the student accomplishes by following Pattison's suggestion.

But consider the purpose of writing. It should be first an act of discovery and then an act of communication; the writer must discover what it is she wants to say before she can say it. Joan Didion in her essay "Why I Write" states that she writes in order to know what she thinks, but for most of our students writing is a classroom activity with complex rules that they do not clearly understand, yet somehow struggle to follow. They write primarily to please that strange breed of human beings known as English teachers. There is no personal discovery for these students, only further alienation from what Pattison calls "the chief vehicle of self-knowledge and social order--language." Remember that Pattison defines literacy as first and foremost "consciousness of the problems posed by language and secondarily skill in the technologies such as rhetoric and writing." If we as English teachers concentrate on the technologies, how do we help make our students truly literate? Kozol in his book Prisoners of Silence suggests that functional literacy goes beyond the ability "to read, write, and comprehend signs, instructions, labels, orders." It also includes the ability to question the legitimacy of all such writing and to participate in and, when necessary, to transform any system or society that works against our interests.[8]

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[8] Kozol, p. 55.

Mindless adherence to half-understood rules is a dead end for our students and utimately for ourselves.

A study published in 1977 by the Department of Health, Education, and Welfare had this to say about the literacy of seventeen-year-olds in this country ten years ago: 90% could understand a job ad in the newspaper; 85% could read a map; an impressive 75% could fathom the phone company's instructions for dialing long-distance. But when asked to write an essay based on a situation shown in a picture, the students'average paper was 137 words long, their average word four letters long. The Department's study concluded that these students could not write well in "an unstructured, non-directive situation,"[9] which, it seems, is the same as saying that they cannot think for themselves.

Changing our attitudes and approach as teachers of English is not a cure-all for our students' lack of critical thought. But if we refuse to get bogged down in the mechanics of writing and instead work on the assumption that our students do have things to say that are worth hearing, we do them the service of withholding our condescension and helping them discover through writing their worth as "thinking" members of a truly literate society.

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9. Pattison, pp. 175-76.

CRITICAL READING DEFICIENCY - CAUSE, SCOPE, REMEDIATION

by

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Critical Reading Deficiency --
Cause, Scope, Remediation

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What is encompassed by critical reading at the university level? One way to define critical reading is by contrast with functional reading. Persons can read functionally if they can extract information from a text to achieve goals that they themselves have established. Whereas functional reading responds to self set goals, critical reading is directed toward the resolution of problems established by others. Thus some persons might possess the functional skills needed to read a magazine effortlesses when they set the limits of this task. However, when someone other than those readers establishes the criteria for successful reading, this second task, a critical reading task, could be inaccessible. Additionally, functional reading skills are restricted to genres of materials with which readers are experienced. Critical reading assumes that persons can transfer skills to specialized texts outside of familiar genres.

Quite often college applicants view themselves as competent readers. They read regularly from predictable types of texts and extract successfully the information for which they are searching.

It is with alarm and confusion that examinees react to failing scores on the verbal portions of admission tests such as the Scholastic Aptitude Test or the American College Testing Program Assessment. Such tests require students to respond to a full range of extremely restricted tasks with passages that are unlike those they confront normally.

During the past two decades, the critical reading skills of highschool students, to the extent that these were reflected in the scores on verbal portions of admission tests, have declined predictably. To some extent this decline mirrors changing attitudes toward standardized tests as a result of the reduced impact that the tests have on decisions about admission to college. Additionally, the demographic porfile of persons who take admission tests has changed. Some observers have pointed out that the accessibility of information through nonprinted media is responsible for declining verbal scores. These arguments are interesting and probably correct as sociological explanations of why test scores have declined. However, a question still remains as to the academic impact of deficient reading scores. Do persons who score in the lower percentiles on critical reading tests constitute a homogeneous group that cannot use texts to meet the requirements of college courses?

To answer this question, a sample of 153 students in basic skills reading courses at New Mexico State University was tested. The elective courses were designed to improve the reading skills of the enrollees. The sample comprised students from six colleges at the

University (Table 1). Forty-nine percent of the persons described their ethnicity as American Spanish. Thirty-nine percent described themselves as American not affiliated with a minority group. The remainder of the sample members included small numbers of students from minority groups other than Spanish American. The Nelson-Denny Reading Test was administered. Reported correlations between this test and the verbal portion of the American College Testing Program Assessment, the test required for all students admitted to New Mexico State University, have ranged from .57 to .65. Scores on the Nelson-Denny Reading Test were converted into grade equivalents (Table 2). Seventy-nine percent of the persons in the sample earned scores below that which would be the equivalent earned by an entering college student. Eight students earned scores that would be appropriate for elementary students in the fifth grade or below.

Upon first examination, these data seem extremely distressing. However, all persons who receive the scores equivalent to those of highschool students, or even those equivalent to elementary school students, are not a homogeneous group of equally disabled readers. Among those persons who score deficiently on a critical reading test may be persons at three distinct levels of development. Figure 1 represents a critical reading stage and two stages of precritical reading. Persons at any of these stages could fail a critical reading test. The etiologies of those failures would be distinct for different cases and the appropriate response could be correspondingly divergent.

TABLE 1

College Affiliations of Students in Sample

College	Number of Students	Percentage of Students
Agriculture	15	10%
Arts & Sciences	31	20%
Business	23	15%
Human & Comm Serv	41	26%
Education	11	8%
Engineering	32	21%
Total	153	100%

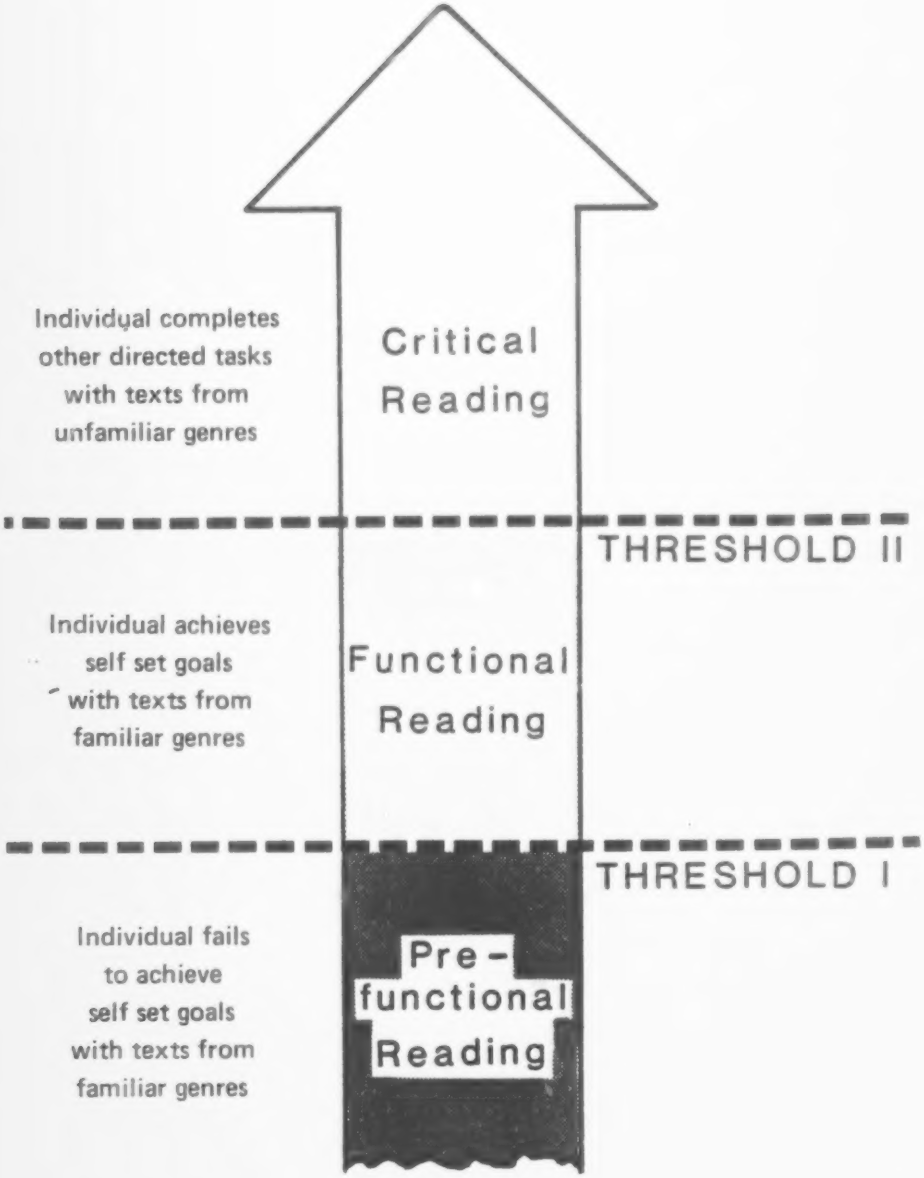
TABLE 2

Grade Equivalents of Critical Reading Test Scores

Number of Students	Grade Equivalents of Reading Scores
1	3.1 - 4.0
1	4.1 - 5.0
6	5.1 - 6.0
2	6.1 - 7.0
15	7.1 - 8.0
12	8.1 - 9.0
15	9.1 -10.0
29	10.1 -11.0
17	11.1 -12.0
20	12.1 -13.0
15	13.1 -14.0
10	14.1 -15.0
5	15.1 -16.0
5	16.1 -16.1+
Total 153	

FIGURE I

THE DEVELOPMENT OF CRITICAL READING


Individual completes other directed tasks with texts from unfamiliar genres
Critical Reading
THRESHOLD II
Individual achieves self set goals with texts from familiar genres
Functional Reading
THRESHOLD I
Individual fails to achieve self set goals with texts from familiar genres
Pre-functional Reading

Students who are adept critical readers, persons with skills developed beyond threshold II in Figure 1, can score poorly because of factors such as unpreparedness for the test, because of idiosyncrasies of the test that do not complement the examinees' problem solving skills, or because of irregularities in the administration of the test. In such cases, students enrolled exclusively in content area courses can be examined several months after failing a test, with a test comparable to that which they failed. And their scores can improve dramatically.

As an indication that equivalent, deficient scores on tests do not indicate persons with a common etiology for that deficiency, 28 students were examined. The freshmen students were examined at the beginning and at the end of 15 week basic skills reading courses. The range of grade equivalents to the early semester tests was 3.8 to 15.2. The mean gain for the group on the late semester test was 2.37 grades. There were two persons in the group who respectively made gains of six years and seven years.

Truely, can persons improve their reading skills so dramatically in such a brief period? If they could, the materials and methods employed in those courses should certainly be marketed; for the graduate students responsible for the teaching would surely become wealthy enterpreneurs. If not common sense, our experience persuades us to suspect the validity of the reading gains that have been documented. If a person has required 18 years to progress to a level of reading characteristic of a fifth grader, there are no arcane strategies that will transfer that person quickly and effortlessly to the plane of reading appropriate for a highschool or college student. The persons who demonstrated advances of six or seven grades assuredly would have demonstrated gains if they had not participated in critical reading courses; the gains could have resulted from circumstantial changes or the adaption to a university environment. Instructors who work with genuinely disabled readers in clinical settings are aware of the time and effort required to advance the skills of a genuinely retarded reader one full grade level.

Just as there are persons who make astronomical gains in reading programs, there are persons who make no gains whatsoever. These are persons below threshold I, persons who have deficient functional reading skills. And finally, there are persons who are between threshold I and threshold II.

Which of these groups requires remedial instruction? Persons beyond threshold II don't require remediation. They may require a different test. Or they may require time to mature or adapt. They need to be monitored, to confirm that they can be successful critical readers; but they do not require remedial instruction.

Persons who are below threshold I, prefunctional readers, require remedial instruction. However, their level of disability is so severe that they are unlikely to benefit from university courses. They might be counseled to find a tutorial type of instruction to reduce their problems. Only after having successfully completed this instruction could they participate effectively in university studies. The individualized remediation that prefunctional readers require is always expensive and often below the minimal baseline of scholarship that defines the missions of colleges.

If there is a group that can benefit from basic skills instruction, that group is composed of persons between threshold I and threshold II, a group characterized by the ability to read functionally but not critically. These persons can read effectively and autonomously -- but they have difficulty transferring these skills to restricted tasks with specialized materials.

Consider the case of private firms that prepare persons for standardized tests. These firms advertise that they can increase clients' scores on tests administered by Educational Testing Service and the American College Testing Program. After participating in a half-dozen workshops, clients will have improved their scores -- or their several hundred dollars in tuition allegedly will be refunded. One can be certain that such refunds are uncommon. The workshops cannot, in several hours, raise aptitudes for programs in law, medicine, or graduate school. And yet the workshops demonstrably can change the scores that are correlated with these aptitudes. What is provided in these workshops is a bank of information about the predictable eccentricities of the testing materials. Once aware of these idiosyncrasies, clients can make decisions about how to adapt skills they've already developed to the testing circumstances.

For parallel reasons, a basic skills critical reading course cannot remediate functional reading deficiencies efficiently. The comparatively modest goal of such courses is to define the problem that students are confronting. In a recent survey of British college textbooks, fifty-one verbal commands were identified as frequently occurring reading task delimiters (Table 3). Depending on the tasks that are specified, students should read the identical passage in distinct manners to be successful. To respond to different tasks it can be appropriate to isolate details, abstractions, main ideas, extrapolations, or the relationships between any of these. The two major instructional foci of critical reading courses are the specification of diverse critical reading tasks and the contraints exerted on those tasks by specialized texts. Such courses assume that students are beyond threshold I, that they are unable to apply the functional reading skills they have already mastered.

Summary

How pervasive is critical reading deficiency among entering college students? Critical reading test scores were reviewed to indicate that 79% of the persons in a sample drawn from basic skills reading courses achieved the scores that would be appropriate for highschool and even elementary school children. The pattern of test scores

TABLE 3

Frequently Occurring Words in Critical Reading Tasks

Survey
Examine
Explore
Memorise
Know
Evaluate
Analyse
Infer
Summarise
Recognise
Recall
Appreciate
Extrapolate
Translate
Synthesise
Apply
Interpret
Identify
Construct
Arrange
Locate
Select
Outline
Find
Create

Respond
Value
Organise
Reason
Demonstrate
Remember
Judge
Discriminate
Deduce
Assess
Create
Consider
Discuss
Conjecture
Describe
Explain
List
Represent
Hypothesise
Appraise
Criticise
Review
Precis
Discover
Compare
Invent

Source: Harri-Augstein, S., Smith, M., & Thomas, L. Reading to learn. London, England: Methuen, 1982.

complements a two decade decline in verbal scores on college admission tests -- a decline that many have equated with the erosion of critical reading skills. However, evidence was reviewed to demonstrate that critical reading scores are not all impervious to instruction. Though some persons don't respond at all, others respond with dramatic advances during brief periods. Among persons who score deficiently, three subgroups can be discerned. 1) Some persons score deficiently because of eccentricities of a test or because of incidental circumstances that influence the test scores. 2) Some persons score deficiently because of inadequate functional reading skills. 3) And some persons score deficiently because they lack a sophisticated sensitivity to the full range of critical reading tasks and to the peculiar patterns of printed materials in the diverse academic disciplines. The research reviewed in this paper supports the establishment of programs that employ alternative measurement instruments to monitor the critical reading skills of entering college students. Additionally, this research provides a rationale for instruction as an efficient means of meeting the needs of at least one group of deficient critical readers.

Acknowledgement: The data discussed in this paper were graciously provided by Timothy O'Leary, Ann Muller, and Dr. Sharon Wooden.

DEVELOPMENTAL STUDIES: A MODEL PROGRAM

by

Michael T. Hoban

LaGuardia Community College

In September of 1970 the City University of New York adopted an open admissions policy that guaranteed a seat in the university to any student with a high school diploma; LaGuardia Community College was one of four colleges established to serve the influx of students. In its first decade LaGuardia's enrollment increased from five hundred students in 1971 to seven thousand in 1981. The original group of eight curriculum majors has expanded to fourteen degree programs and one certificate option in the areas of liberal arts, business, and allied health professions.

LaGuardia's missions have remained the same: to serve appropriately and effectively the needs of each segment of a diverse population; to give special emphasis to preparation of the individual for work and/or further study; to combine practical field experience with classroom instruction through a mandatory cooperative education program; and, through an extensive developmental studies program, to assume a special responsibility for service to adults, the handicapped, veterans, non-English speaking students, and other populations generally excluded from the mainstream of higher education.

The success with which LaGuardia has fulfilled these missions can be judged in part by the following two distinctions: In 1976, the United States Office of Career Education named LaGuardia a model cooperative education college in the United States; in 1982, the National Association for Remedial/Developmental Studies in Postsecondary Education (NARDSPE) presented its first annual John Champaigne Memorial Award for Outstanding Developmental Programs to LaGuardia Community College.

Developmental Studies Program

LaGuardia Community College accepted a responsibility to compensate for the basic skills deficiencies and second language difficulties of its students. The college's mission was established, its programs designed, and its faculty hired specifically to meet the needs of open admissions students. Over the years the priorities have frequently been re-examined and the approaches refined, but commitment to career education and to nontraditional learners remains unchanged.

The comprehensive developmental studies program at LaGuardia is a direct outgrowth of the college's commitment to open admissions students. Experience in the early 1970's with basic skills courses and support services convinced the faculty that an effective program must have at least two phases to it. The first would be the basic skills program itself: special courses in reading, writing, and mathematics, tutoring services, special counseling help, and so on. The second phase would be a systematic effort to help all faculty reinforce basic skills in all content area courses. Our experience suggested that for students to make permanent the gains acquired through basic skills courses and services, faculty in regular courses must know how to reinforce those skills in their classrooms.

Consequently, Phase I, the Basic Skills Program, is a tightly coordinated program designed and administered to ensure that all students acquire and demonstrate those skills necessary for success in their other courses and subsequent careers. Phase II, Integrated Skills Reinforcement, is a highly structured faculty development program designed to help faculty reinforce basic skills in their classrooms.

Phase I - The Basic Skills Program

LaGuardia's approach to developmental education must be understood in the context of the scope of its program. In the Fall of 1981 the college admitted 3000 new students. All students were tested for placement in reading, writing and mathematics before being allowed to register. The percentage of students with special needs in these areas was as follows: reading, 51 percent; writing, 70 percent; and mathematics, 77 percent. Nineteen percent of the students needed special instruction in English as a second language. To accommodate these students, the college offered 360 sections of basic skills courses in the fall quarter alone. The students were enrolled in "packages" of courses depending on their reading and writing capabilities. In addition to courses in reading, writing, mathematics, and ESL, the college also included in these packages courses in oral skills and critical thinking skills as well as weekly group counseling sessions conducted by a counselor. At the end of each of the sequences in reading, writing, and mathematics, each student was retested on an alternate form of the placement test to certify minimum competency.

For example, a student reading below the seventh grade level would receive the following package of courses in his first quarter at the college:

CSE 096	Basic Reading Workshop	5 hours
HUC 098	Basic Comm. Strategies I	4 hours
ENG 097	Basic Writing I	4 hours
Freshman	Seminar (orientation and group counseling)	1 hour

This program requires 14 hours of study each week and carries a total of 1.5 credits for the quarter. The student is encouraged to spend additional time as needed in the tutorial centers conducted by the departments involved in the basic skills effort.

There are 15 distinct courses in the college's Basic Skills Program. As indicated above, students receive mandatory assignments in packages of courses that are based on individual prescriptions determined by their placement test scores. The courses are:

		Classes	Labs	Credits
CSE 096	Basic Reading Workshop	3	2	½
CSE 097	Basic Reading I	3	2	½
CSE 098	Basic Reading II	3	2	1
CSE 099	Basic Reading III	3	2	1
ENG 097	Basic Writing I	3	1	½
ENG 098	Basic Writing II	3	1	½
ENG 099	Basic Writing III	3	1	½
HUC 098	Basic Communication Strategies I	3	1	½
HUC 099	Basic Communication Strategies II	3	1	½
MAT 098	Basic Mathematics I	4	1	1
MAT 099	Basic Mathematics II	3	1	1
ESL 096	ESL Workshop	7	2	1½
ESL 097	Eng as a Second Language I	2	2½	
ESL 098	Eng as a Second Language II	6	2	2½
ESL 099	Eng as a Second Language III	6	2	2½

The Basic Skills courses are offered in the following departments:

Communication Skills Dept. (reading)	CSE 096,	097,	098,	099
English Dept. (writing)	ENG 097,	098,	099	
Humanities Dept. (oral skills)	HUC 098,	099		
Mathematics Dept.	MAT 098,	099		
English as a Second Language Dept.	ESL 096,	097,	098,	099

Each of the five departments supervises its own tutorial center staffed by both full-time and part-time tutors. These tutorial centers provide a major support service offered by the college to enable students to advance at their own pace. The centers are generally open from 8 A.M. to 8 P.M. and are an essential feature of the developmental studies program. The tutorial centers are also the site of lab sections of various classes.

Administration. A program of the scope of LaGuardia's requires a great deal of coordination to operate efficiently. The college administration has recognized this need and been consistent in its support of this crucial aspect. The program is coordinated by the Director of Developmental Studies, a full time administrator reporting directly to the Dean of Faculty. A major task of the director is to ensure close communication among the five departments directly involved in the Basic Skills Program and between departments and the Basic Skills Office. The director heads the Basic Skills Office which handles all administrative aspects of the program such as placement testing of all students, retesting to ensure minimal competency, monitoring of students' progress, and so on. The Assistant Director of Developmental Studies is also an Assistant Registrar at the college; this arrangement ensures that all students are registered for the appropriate courses and sequences.

Perhaps the most important element in the coordination of this program is the Basic Skills Task Force, a standing committee of the college composed of a designee from each of the departments and divisions of the college (fifteen members in all) and chaired by the Director of Developmental Studies. The Task Force monitors all aspects of the Developmental Studies Program and recommends appropriate program refinements based on information collected from students, faculty, and administrators. The following are a few examples of policies that the Task Force has initiated:

1. A student may not drop a basic skills course

from his schedule except for extraordinary reasons and with special written permission from the instructor and the student's counselor. Since the student did not choose to take the course (it is mandatory) he may not elect to drop it.

2. Students entering college with developmental needs have very different skills backgrounds. Even with a carefully designed placement program, students in the same basic skills course sometimes have widely divergent skills levels. For this reason, besides the usual grades of A, B, C, D, F, and so on, instructors of basic skills courses may assign a grade of R. This is a non-punitive grade which indicates that the student has made significant progress but has not yet reached the exit criteria for the course. A student receiving an R grade must repeat the course.

3. All college courses have clearly defined prerequisites in terms of basic skills courses. This ensures that students have the appropriate educational skills to cope with the demands of the course. This policy is the result of a two-year effort recommended by the Basic Skills Task Force and carried out by the college's Curriculum Committee. The following example is taken from the college Bulletin:

> BDP 105 Computers and Society 3 hours, 3 credits
>
> This course is offered as a non-technical course for all the students interested in understanding the myths and realities of our computerized society. The intent is to familiarize the student with the terms and problems of the computer age. Basic knowledge of computer equipment and computer programming will be covered in terms of vocabulary of the computer world as well as actual experience with computer equipment. Each lecture will be related to a specific application of computers such as voting analysis, education, health, credit card billing systems, transportation and government systems.
>
> Prerequisite: CSE 098, MAT 098, Eng 099.

To the casual observer, LaGuardia's approach to developmental studies might seem an obvious one to adopt. Carefully coordinated procedures ensure appropriate placements. Linguistically integrated skills courses present a holistic approach to language learning. Teachers, counselors, and tutors functioning as a team ensure student progress. Standardized exams certify proficiency levels. Separate developmental and ESL sequences address the intrinsic differences between first and second language learning. Finally, a carefully planned prerequisite system addresses the issues of standards in content area courses.

These obvious features, however, represent a series of critical decisions made by the Basic Skills Task Force and the academic departments over a period of years. They reflect a willingness by the faculty, with the support of the administration, to discard unsuccessful practices and to approach with energy any intelligent procedures that might yield results.

Examples. Three current examples of our attitude towards developmental studies are worth noting. After two years of discussions, the mathematics department in 1980 adopted the position that in light of the availability of the hand calculator, the "basic arithmetic course" for college students should no longer have as its prime emphasis practice in algorithmic drill (e.g., how to do long division). Rather, the ability to solve problems should be the major emphasis of the course and students should be taught how to use the hand calculator intelligently. Topics such as estimation and approximation thus became important tools in the problem-solving process. A group of four faculty members developed materials for such a course and these materials have been used and refined over the past two years. The course represents a realistic educational approach to meet student needs rather than the continuation of traditional practices made questionable by the technological advances of our society. With the hand calculator and appropriate teaching materials, the time previously spent on non-productive drill can now be utilized far more profitably in learning and applying problem-solving strategies.

In 1978 the philosophy department began the development of a course in critical thought skills. Over the next three years the course was tested, evaluated, revised, and finally adopted as a "companion course" to the Basic Skills Program. The faculty in the philosophy department felt that the ability to think critically is truly a basic skill; so they pursued grant funding in order to carry their project still further. The department has since received substantial funding from the National Endowment for the Humanities to conduct a three-year cooperative effort with faculty in reading, writing, oral communications, mathematics and social sciences to infuse the teaching of critical thinking skills into these disciplines. The goals of the project are to systematically teach, integrate and reinforce the basic conceptual and thinking skills which are needed for academic studies and ordering life experiences; to provide a multi-disciplinary framework which will stimulate in students the process of self-awareness and personal growth; and to develop concrete teaching materials which reflect curriculum integration and can be replicated and used elsewhere. This effort began in the fall quarter of 1982 and will continue through 1985.

The third example of current work in developmental studies represents a joint effort by the English and data processing department in the college. The departments have been successful in obtaining grant funds to experiment with the use of microcomputers with word processing capabilities to teach basic writing skills to students. The project began in the Fall quarter of 1982 and its focus is on those students who do well in technical courses but have great difficulty mastering basic writing skills.

Phase II - Integrated Skills Reinforcement (ISR)

As the Developmental Studies Program evolved during the 1970s LaGuardia faculty realized that the students' recently acquired educational skills declined rapidly unless used and reinforced. Thus, the belief grew that a truly effective program must engage all instructors of first-level regular college courses in the reinforcement of basic skills. With this goal in mind, the college in 1977 put together a team of four faculty members under the direction of Professor JoAnn R. Anderson, a communication skills specialist. The team's task was to design a faculty development program which would systematically retrain faculty to teach in their disciplines while simultaneously reinforcing basic reading, writing, oral and listening skills.

The product of the team's efforts, a program first piloted in 1978, is a highly structured inservice training program which assists content area instructors to consider the roles of reading, writing, speaking and listening in their courses; to determine the level of skill the student needs to meet course objectives; to use classroom techniques adapted from basic skills courses; to design lesson plans which help to extend the student's mastering of skills; and to make the student's effective use of skills part of the grading process.

The cornerstone of the program is a 300-page manual, ISR: Integrated Skills Reinforcement (Anderson, Eisenberg, Holland, Rivera-Kron, & Wiener, in press). Since 1978, thirteen to twenty instructors have been trained each year. The college has invested heavily in the program and substantial grant funds have also been obtained. So successful has the ISR project been that Bronx Community College of City University of New York, has obtained a grant for members of the LaGuardia team to train a team of Bronx faculty in ISR strategies.

Briefly, the ISR training program both informs and supports the participating faculty members. A department nominates a faculty member (in some cases more) to participate in the program for the year. There is no negative connotation to this nomination because the original ISR faculty-trainees in 1978 were carefully chosen from among the most respected teachers. The goal of the training is not to make "good teachers out of bad teachers;" no program can do that. Rather, it is to acquaint effective teachers with instructional strategies aimed at reinforcing reading, writing, oral and listening skills in their courses and provide opportunity for practice. The ISR program requires a two-quarter commitment from the instructor. The instructor is released from teaching one course during each of two quarters.

During the first quarter a faculty-trainee selects a course he or she will be teaching during the next quarter. The trainee studies the strategies in the ISR Catalog and devises classroom applications for a single unit in the selected course. The emphasis on the single unit (often the first chapter in a text) is important because the trainee should not view the strategies as separate entities but rather as integrated skills reinforcement. During the quarter these activities are coordinated by a faculty-trainer (often one of the co-authors of the ISR Catalog). Three or four trainees meet each week for a two-hour session with the trainer to review their progress in the development of these materials. By the end of the first quarter the trainee has developed the materials to be tested in the classroom.

During the second quarter the instructor tests the materials in the classroom and uses extensive video taping to review the presentation and students' responses. The instructor also meets regularly with the faculty-trainer and his fellow trainees to discuss progress. The instructor revises the materials based on classroom experience. By the end of this quarter the instructor has completed the materials needed to integrate ISR strategies with the rest of the course syllabus and exams. The experience of the ISR Program over the past few years has shown that if faculty development in basic skills reinforcement is to be effective, it must rely on group settings and on the leadership of faculty in the skills areas to structure and supervise systematic training.

Does The Developmental Studies Program Work?

The evaluation of a developmental studies program is a problem that confronts many educators. What data to collect and how to analyze the collected data are subjects for debate among different groups. Since 1971 the Office of Institutional Research at LaGuardia has conducted many studies of significant value which have led to refinements indicated by the analysis of student and faculty feedback and statistical data. Because of the difficulty in defining the term "success" for nontraditional college students, it is questionable whether a developmental program can be evaluated in the summative sense of the term (i.e., does the program succeed?). Educators, however, must attempt to gather data so that some criteria can be applied to determine whether what program personnel are doing is worthwhile.

Some educators believe that student attrition is one valid measure of the success of a developmental program. They would argue that students who are no longer in the college cannot be helped by the college. A study conducted by the central office of the City University of New York is of interest in this context. The study involved students who entered the nineteen colleges of the university in the Fall of 1978. Students were separated into two groups: those whose placement tests indicated a need for instruction in basic skills (reading, writing, math) and those who tests indicated no such need. The study then gathered data about the students who were still in the university in the Spring of 1980.

The study showed that for the university as a whole (and for community colleges as a group) attrition among students who entered needing basic skills instruction was greater than that for students who needed no such instruction. This was, of course, not very surprising. For LaGuardia, however, the data showed an unexpected result: Attrition among students at LaGuardia who entered needing basic skills instruction was less than attrition among students who needed no basic skills help. Since the college does have academic probation and suspension policies, this result seems to be significant. The program helps underprepared students to stay in college, continuing their education.

LaGuardia's developmental program has many levels. For example, a student may enter needing only one basic skills course in one area, or needing as many as twelve basic skills courses spread over a number of academic areas. Some educators would argue that the best measure of the success of a developmental program is whether a student who enters at any level can achieve the associate degree. A study was conducted of the students eligible for graduation at LaGuardia in March, 1981, the end of the Winter quarter. The study revealed that of the 210 students eligible to graduate that quarter, 83 percent had needed basic skills instruction when they entered. A close look at student records indicated that graduates had entered LaGuardia at every entering skills level. The study indicates that, given motivation and perseverance, students can enter the program at any skills level and expect to graduate.

In his letter to President Joseph Shenker of LaGuardia Community College on the occasion of the awarding of the first John Champaigne Memorial Award, President Hunter R. Boylan of the National Association for Remedial/Developmental Studies in Postsecondary Education (NARDSPE), stated that the award was given to LaGuardia's developmental education program because it represented "the best of current practice in the field." He also stated that the award was granted to LaGuardia "because of its long-standing commitment to excellence in developmental education; its use of current research and methodology in the design of program services; and the high quality of its services to students."

We at LaGuardia are proud of what we have accomplished in the field of developmental education over the past twelve years. We are, however, equally aware that we have just begun to scratch the surface in our goal of enabling each student to succeed in his or her education. Questions such as how to use the microcomputer in developmental education will continue to keep us alert. We know that we will never have all the correct answers. We must, however, take great care to ensure that we continue to ask ourselves the right questions.

FOLLOW-UP STUDIES OF
TEACHER EDUCATION PROGRAM GRADUATES

by

Edward L. Kirk

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FOLLOW-UP STUDIES OF TEACHER EDUCATION PROGRAM GRADUATES

> The institution keeps abreast of emerging evaluation techniques and engages in systematic efforts to evaluate the quality of its graduates upon completion of their programs of study and after they enter the teaching profession. This evaluation includes evidence of their performance in relation to program objectives.
>
> The institution regularly evaluates its teacher education programs and uses the results of its evaluation in the modification and improvement of those programs. (1:11).

I. INTRODUCTION

Why Follow-Up Studies?

There is little doubt as to the necessity for periodic follow-up studies of teacher education program graduates by those institutions which desire approval by The National Council for Accreditation of Teacher Education (NCATE). Standard Six is very clear on this point. If it were not for this mandate, many schools would doubtless neglect to study the outcomes of their own efforts. Why this reluctance? One possible explanation might be that the anticipated effort, cost, and time requirements of such a study are a bit discouraging. Maybe the expectation that the study will yield very little that can be used in program planning and improvement is another discouraging factor. Also, those who are responsible for teacher education programs might be somewhat apprehensive about the results of such a study. (2:18).

The Values of a Follow-Up Study.

A properly planned and executed follow-up study of teacher education program graduates can be of great value. Although an institution may be visited by NCATE representatives only once in seven years, representatives from the state department of education probably show up more often. University administrators, boards of trustees, and others may want justification for existence at any time. Follow-up study data can provide evidence to assist in that justification. This responsibility becomes increasingly difficult without the benefit of accurate data from a defensible follow-up program. But evaluation data should not be just for NCATE or state representatives; it should be for those who are actually engaged in preparing teachers and in the designing of programs to meet their needs. (4:24).

A properly planned and executed follow-up study of teacher education program graduates should reveal:

(1) The extent to which the graduates are accomplishing the personal and professional goals for which they were prepared.

(2) The effectiveness of various aspects of the teacher education program.

(3) The strengths and weaknesses of the teacher education program as perceived by its graduates.

(4) Suggestions for program improvement based on the results of responses made by graduates of the program.

(5) The mobility and location of program graduates.

(6) The number or percentage of program graduates who were employed immediately upon graduation.

(7) The number or percentage of program graduates who accepted employment in areas other than teaching.

(8) The number or percentage of program graduates who continue in school rather than seek employment.

An effective follow-up study of teacher education program graduates should provide information helpful in answering such questions as course effectiveness, the proper sequence of courses, factors relating to the achievement and success of graduates after entering the teaching profession, better methods of instruction, and the degree to which the stated objectives and competencies of the teacher education program are being realized.

II. THE NCATE REPORTS

The NCATE Reports in General.

According to NCATE, the maintenance of "acceptable teacher education programs demands a continuous process of evaluation of the graduates of existing programs. . ." (1:10). There can be little doubt but that NCATE Standards have stimulated the conducting of follow-up studies of teacher education program graduates. In spite of the stimulation applied by NCATE, violation of the Standard calling for the follow-up studies was cited as a weakness in fifty-eight percent of the programs reviewed during 1979, a rate second only to the violation of the governance standards. (2:18).

An Examination of Ten NCATE Reports.

Ten specific reports submitted by institutions to NCATE from 1971 to 1981 were examined with special attention being given to that section of the report dealing with "Evaluation, Program Review, and Planning." (Standard Six, 1981). No method of random sampling was utilized in choosing the reports to be examined; the ten which were readily available were utilized. (5:0).

A Summary of the NCATE Reports.

After examining the ten reports submitted to NCATE by the various institutions desiring NCATE approval, the following observations or conclusions relative to them seem warranted:

(1) Standard Six of the NCATE Standards is a definite stimuiant to the conducting of follow-up studies of teacher education program graduates.

(2) The intervals at which follow-up studies are conducted seem to vary from three to ten years. This may be open to question as it was not always possible to determine the exact interval from the informaton contained in the NCATE reports.

(3) Almost all schools seem to utilize a variety of informal ways to attempt to assess the effectiveness of their work.

(4) Most formal follow-up procedures utilized a survey questionnaire mailed to teacher education program graduates and to their principals or supervisors.

(5) Relatively few of the schools utilized the National Teachers Examination or other measures which would enable them to compare their graduates with some type of national standard or norm.

(6) Most of the schools utilized some type of pre-service evalution of specific courses by the teacher eduction program participants.

(7) Most of the schools attempted to analyze the results of their follow-up efforts in some way. The analyses ranged from simple tabulations to the use of elaborate charts, comparisons, and statistical procedures.

(8) Most of the schools indicated some attempt to utilize the results of their follow-up studies for program improvement or modification.

III. RECOMMENDATIONS

The Questionnaire.

Since the use of some type of questionnaire to first year teachers and to their immediate supervisors appears to be the most widely used technique for securing information about the effectiveness of teacher education programs, the following suggestions are offered in connection with the use of such questionnaires and about follow-up studies in general:

(1) Although there may be a desire to send questionnaires to all graduates to exhibit an interest in everyone, consider using a carefully chosen sampling technique to select a sample from the class or group to be surveyed. The use of such a sample is common in surveys today and has proven to be an effective practice in many situations.

(2) The group to be surveyed should be identified at least one year prior to their graduation so that they may be oriented as to the nature and importance of the follow-up study before they leave the campus. This planning with students while they are still in school will cause them to be more likely to respond and to recognize the value of the study since they understand why it is being conducted.

(3) Consider the possibility of encouraging certain groups of students to help plan the study and to assist with the collection of the data so that they learn from firsthand experience how the results are to be used to improve the program of preparation.

(4) An individual should be designated to be responsible for the follow-up study early enough to allow that person to plan and execute the on-campus orientation. Perhaps the chairman of the education department, the certification officer, or the director of laboratory experiences should be responsible for the study.

(5) Every effort should be made to maintain contact with the graduates of the target group or class between the date of graduation and the time of the follow-up study.

(6) Questionnaires should be accompanied by a cover letter which explains how the results will be used, why responses are needed from everyone, and how confidences will be kept.

(7) The appearance of the questionnaire will have considerable effect upon the percentage of returns.

(8) Arrangements should be made to follow the original questonnaire with a personal letter urging return of the questionnaire.

(9) Check with a legal counselor to determine if first-year teachers should be asked to sign a form authorizing their supervisor or administrator to evaluate their performance on the administrator's form of the questionnaire.

(10) Provisions should be made for additional mailings to those who do not respond.

(11) Arrangements should be made for machine processing of the questionnaire and for statistical analysis by a computer system whenever possible.

(12) An address list should be compiled as soon as possible utilizing all available resources—certification files, alumni files, placement files, letters to parents, telephone directories, etc.

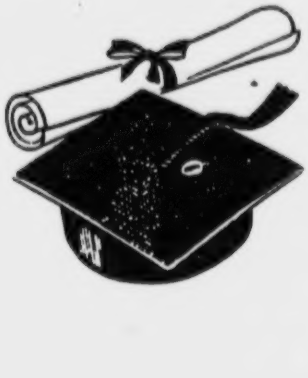
(13) Investigate the possibility of making the questionnaire a durable mailout on a single sheet which can be folded, sealed, and mailed directly.

(14) Investigate the feasibility of telephoning non-respondents, especially if the total response rate falls below sixty percent of the total sample.

(15) A summary of the results of the follow-up study should be provided to those who might profit from knowledge of the results. Steps should be taken to implement modifications of the teacher education program as indicated by the results of the study.

What About On-Site Interviews?

While the distributed questionnaire, organized in a check-off format, has the advantage of clear-cut responses and can yield a good return, especially if mandated by an administrator, there is the problem of what to do with the answers to assure their validity or to expand on the suggestions which are made. Depending upon the objectives which one expects to achieve, an on-site interpersonal approach may be better. The respondents are more apt to respond openly to a frank discussion than to a series of blanks on a sheet of paper. Although it may take much more time to find out what's going on, the personal effort can be worthwhile in developing reliable information. The relationships among teachers, administrators, and others, hidden by individually checked questionnaires, may be made much more evident by face-to-face interviews. It would be an administrative decision as to whether or not on-site interviews are productive enough to warrant the time, effort, and expense involved. (3:24).



NOTES

1. *Standards for Accreditatin of Teacher Education.* Washington: *National Council for Accreditation of Teacher Education.* March 1, 1981.

2. Lillian Katz, James Rath, Chandra Mohanty, Akemi Kurachi, and Joyce Irving. "Follow-up Studies: Are They Worth The Trouble?" *Journal of Teacher Education.* March-April, 1982. Volume XXXII, Number 2.

3. Jon T. Powell. "Developing an Effective Survey." *Media and Methods.* January, 1982. Volume 18, Number 5.

4. Ronald Adams, James Craig, Shirley Hord, and Gene E. Hall. "Program Evaluation and Program Development in Teacher Education." *Journal of Teacher Education.* September-October, 1981. Volume XXXII, Number 5.

5. Reports submitted to NCATE by the following schools were examined:

   Saint Mary College. Leavenworth, Kansas. 1971
   High Point College. High Point, North Carolina. 1975.
   Bethany College. Lindsborg, Kansas. 1975
   Southern Missionary College. Collegedale, Tennessee. 1976.
   Central College. Pela, Iowa. 1978.
   Custavus Adolphus College. St. Peter, Minnesota. 1978.
   Carleton College. Northfield, Minnesota. 1979.
   Albany College. Albany, Georgia. 1981
   Indiana Central University. Indianapolis, Indiana. 1981.
   Livingston Unviersity. Livingston, Alabama. 1981.

THE IMPORTANCE OF WRITING TO CHEMICAL ENGINEERS

by

R. L. Long

New Mexico State University

Abstract

An article titled "Putting College Back on Course" appeared in the September 19, 1983 issue of Chemical Engineering. The authors reported the results of a survey to which 3599 U.S. educated chemical engineers responded. The survey directed questions at graduates from schools of chemical engineering over the last ten years regarding the effectiveness of their undergraduate education. One result of this survey was that writing skills were rated second in importance to chemical engineers after material and energy balance calculations. It was also a subject which was formally studied by only 3.9% of the graduates in college. Added work in this area was done after graduation by approximately 62% of the chemical engineers responding to the survey, either by seminar participation or self study through correspondence courses.

Since the chemical engineering curriculum is already crowded, it would seem that the only feasible way to develop writing skills is to build relevant assignments into the existing curriculum. Writing is done primarily in laboratory courses and in senior design. However, each course has homework, and instructions for homework composition are also needed. The presentation of tables, figures, and calculations are often an integral part of engineering writing. A guide to writing was prepared by the faculty and has been adopted as a departmental standard to assist the student in developing effective writing skills.

One comment from a survey participant in the above mentioned article is relevant to all persons interested in education:

"It is unreasonable (even cruel) to send people into a real world unprepared for reality." (Dennis Stewart, McKees Rocks, PA).

The Importance of Writing to Chemical Engineers

Introduction

The educational process has two principal objectives: 1. conveying the factual content of a subject to the student; 2. developing student learning, communication, and thinking skills. The latter is by far the more important and difficult task.

Traditionally, engineering education has emphasized technical content of subject matter and to some extent assumed the existence of learning, communication, and thinking skills. Since engineering is by its nature a problem solving activity it develops student ability to solve problems in content areas. However, because the factual content of an engineering education is so large, less emphasis than is perhaps warranted has been allocated to development of communications skills and styles of learning.

Evidence supporting the argument that inadequate attention has been paid to development of engineering student communications skills is found in the fact that some large industrial companies have a policy of sending all newly employed entry level engineers to writing seminars at company expense. The companies apparently feel the investment is worth the money. It does suggest, however, that there is a chasm in the education of engineering students which could be filled by appropriate skill development activities. While we might argue about the screening role of educational institutions, we must also consider what the basic skill levels should be for any task. This gives both student and teacher an objective standard against which to compare performance.

We have all seen expressions of concern in the national media regarding aptitude and skill performance levels of American students versus other national groups or even versus ourselves in previous decades. Perhaps the time has arrived for significant reemphasis in basic skill development at all levels of education.

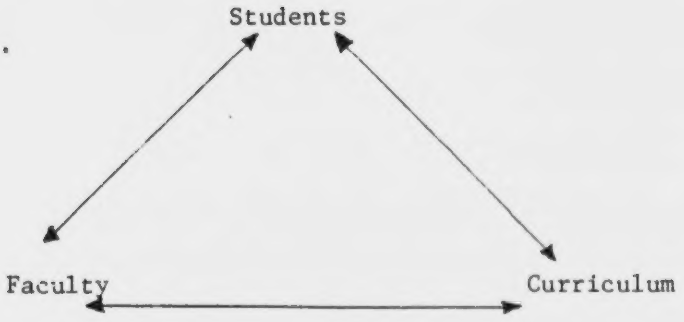
Background

An article titled "Putting College Back on Course" appeared in the September 19, 1983 issue of Chemical Engineering. A nationwide survey of 3599 graduates of U.S. chemical engineering programs in the last decade revealed that writing skills were rated second in importance after material and energy balance calculations by the graduates themselves. Yet only 4% of the students had formal training in these skills in college while 62% took additional formal training in writing after graduation.

Elements of an Engineering Education

Engineering education results from the interaction among three elements: the faculty, the students, and the curriculum. This is illustrated in Figure 1. For this reason, each element is essential to the process. In addition, some specialized equipment and materials such as laboratory facilities and library resources are required.

Consider the source of engineering educators: they are principally the best of the PhD graduates of engineering curricula. Some, but not all, will have several years of industrial experience. This is quite appropriate since an effective teacher should know the subject. However, as with other university disciplines there is no requirement for the faculties to have any formal training in teaching methodology or educational psychology. The result is that in our early teaching careers we teach on the basis of "instinct" and knowledge of subject matter. Gradually, we each discover a


Students
Faculty
Curriculum

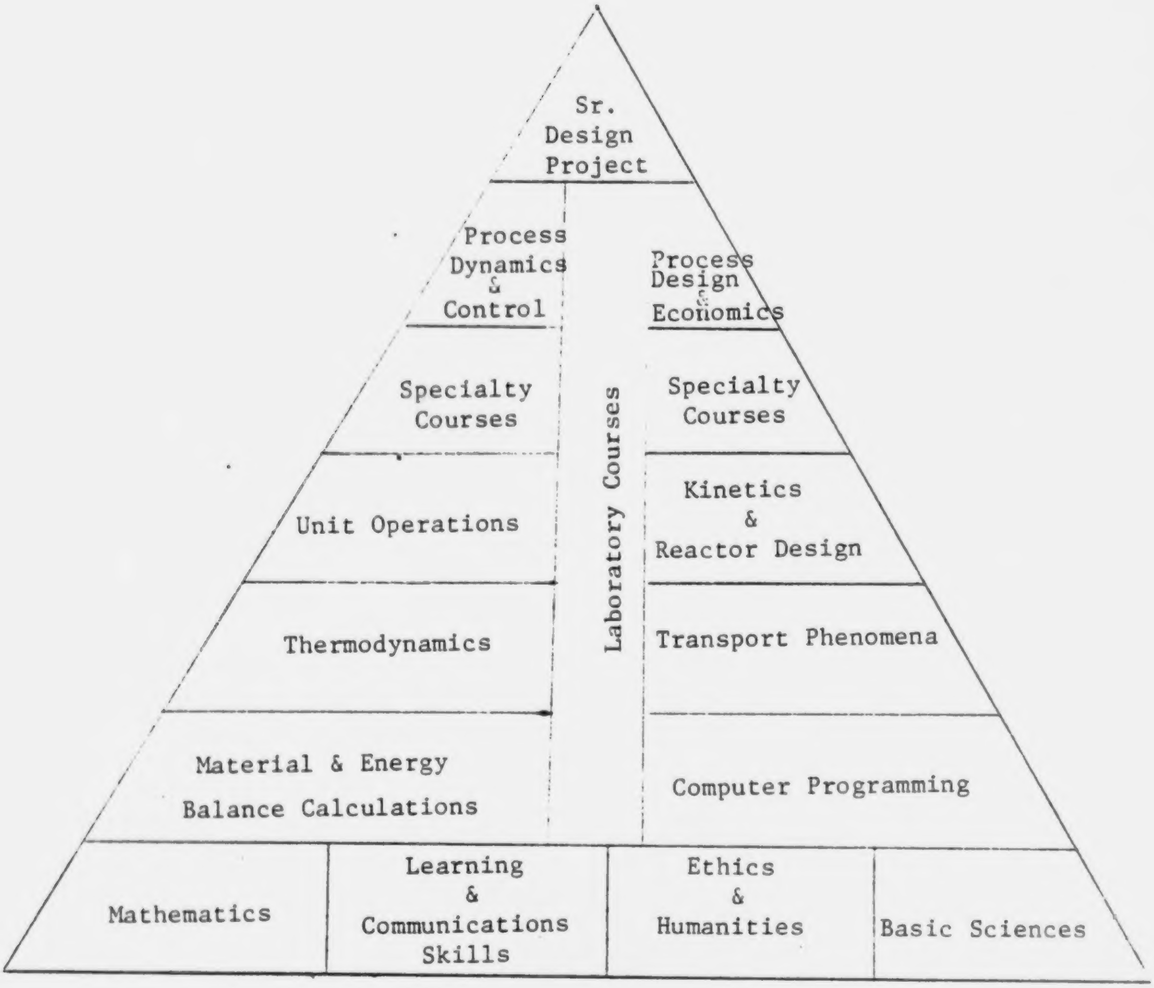
Key Elements of an Engineering Education

Figure 1

"style" suited to our personalities. Depending on personal inclination this can lead to a wide range of methods to develop student skills. Since most of our own educations heavily emphasized problem solving and deemphasized writing and other communications skills until at least the graduate level, it takes some time to realize that these skills can and should be addressed at the undergraduate level.

Consider the students entering an engineering program. They are typically high school graduates with strong problem solving skills (by comparison with their peers, at least), but sometimes they have less well developed verbal skills. They believe they like technical subjects, and they can see the obvious utility of an engineering education. However, they usually have only a vague notion of what engineering is.

Consider the curriculum. Figure 2 illustrates the structure of the undergraduate chemical engineering curriculum. It consists of basically lecture courses and laboratory courses. Lecture courses are interactive between teacher and student through question and answer and demonstration by the teacher of solution methods to problems. The laboratory courses are interactive again by question and answer and also by illustration of how to use equipment. The tasks which must be performed by engineering students in lecture courses are primarily a series of homework exercises. These are usually groups of highly structured problems to be solved and they require the student to apply his knowledge of the subject matter in combination with more general problem solving methods. This develops the student's ability to solve such highly structured problems. Typically, less well structured problems (design-type problems) are left to senior level courses where the student begins to have enough technical knowledge to attack these kinds of problems. In the chemical engineering curriculum, a senior level design project is


Sr.
Design
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&
Control
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Economics
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Laboratory Courses
Unit Operations
Kinetics
&
Reactor Design
Thermodynamics
Transport Phenomena
Material & Energy
Balance Calculations
Computer Programming
Mathematics
Learning
&
Communications
Skills
Ethics
&
Humanities
Basic Sciences

An Undergraduate Chemical Engineering Curriculum Model

Figure 2

required for graduation. Indeed, a national contest is sponsored by the American Institute of Chemical Engineers and they furnish this project problem to all participating schools for use during a particular 30 day period in the spring semester of the senior year.

The basic elements of solving the determinant type of problem typical of the undergraduate chemical engineering education are illustrated in Figure 3.

In the laboratory courses, the tasks to be done are experiments which require manipulation of equipment and materials. They require the recording of information about the performance of the equipment and materials. An evaluation of the results obtained is done and a report is turned in to the instructor. Thus the written tasks in the laboratory courses are of two types: (1) laboratory notebooks and (2) laboratory reports.

What, then, are the basic written tasks which must be performed by the chemical engineering students? They are:

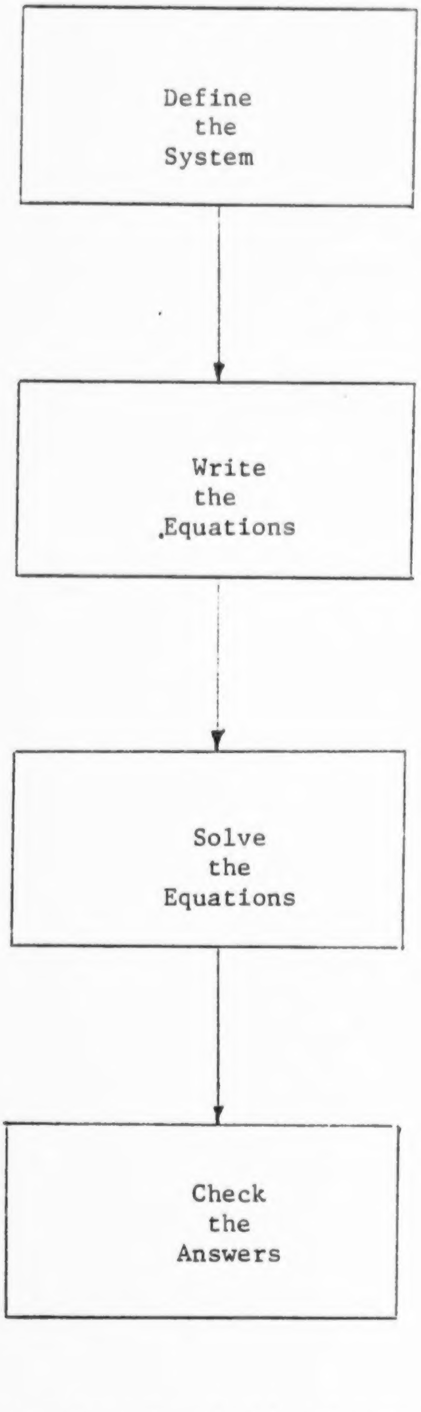
(1) homework (including computer programs)

(2) laboratory notebooks

(3) laboratory reports

(4) senior design report(s)

Thus it appears that with a little effort, the opportunity exists to structure the numerous written assignments in such a way that writing skills as well as problem-solving skills are developed. By setting departmental standards for such perennial student difficulties as organization, format, and mechanics we can help the student focus on structuring his thought processes about the task at hand. This has, in addition, the added benefit of making the work easier to grade because the faculty will know where on the student papers to look for particular steps. Since engineering writing is very likely to be different from his previous writing experiences, we can do the student a real favor by


Define
the
System
Write
the
Equations
Solve
the
Equations
Check
the
Answers

A Chemical Engineering Problem Solving Model

Figure 3

simply making him aware of the fact that a difference in expectation exists. To do this, we must provide standards which are as uniform and objective as possible.

Addressing the Problem

Reflection on these problems and opportunities by faculty in the Department of Chemical Engineering at NMSU led us to form an interested group to address this issue. To assist in keeping the treatment of the issues balanced, a faculty member in the department of English was added to the group. Several meetings ensued, and it was agreed that a student guide and departmental standard for all written work should be prepared. After some discussion we agreed on a division of effort. Each of us prepared our work in our own areas and submitted copies to each other for review before each succeeding meeting. During this process we decided to broaden the scope of our effort to include an effort dealing with some aspects of problem solving. A general editor was chosen from the group. His job was to manage the overall effort.

A draft was produced and tested by the students for a semester. Their comments were received and over the summer the editor undertook a major revision. This effort was reviewed by the other authors in the late summer of 1983 and the first edition of our guide was issued as a departmental standard in the Fall of 1983. Since that time, comments have been received from a variety of interested parties and a second major revision has been undertaken. The second revision has just been completed and will be issued to our students this spring. Figure 4 presents the Table of Contents of our new version of the guide. Of course, the copyright is being registered.

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A Guide to Writing and Problem Solving for Chemical Engineers

Figure 4

Results and Conclusions

What have been the results of the use of our guide? When the project was undertaken we had some discussion about how to measure results, but we concluded that the need for some sort of guide was so great that we should proceed with producing it for student use as soon as possible. Thus we disregarded formal instruments for measurement of its results. Indeed, it would be very difficult to devise a control group study in our department because it would be impossible to prevent the guide from getting into the hands of the control group.

Therefore, at this point in time we have only our own judgement of the results of our effort combined with student comments as to its helpfulness. The fact that all faculty in our department, and not just those who participated in the preparation of the guide, have adopted it as a standard strongly suggests that the need was felt by all of us and the resulting guide is considered very helpful by all of our faculty. As for the student view, the comment of one student on an anonymous faculty evaluation perhaps reflects their attitude best:

"A good book. Well worth the price."

References:

1. Barna, B., Bridges, C.W., Long, R.L., Rakow, A., *A Guide to Writing and Problem Solving for Chemical Engineers*, NMSU, 1983.

2. Lipowicz, M.A., and Hughson, R.V., "Putting College Back on Course," *Chemical Engineering*, September 19, 1983.

COGNITIVE MODIFIABILITY FOR INDIAN ENGINEERING STUDENTS

by

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and

Marjorie Burr

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COGNITIVE MODIFIABILITY FOR INDIAN ENGINEERING STUDENTS

Lance Lujan and Marjorie Burr

Indian Resource Development, New Mexico State University

Retention of college students enrolled in engineering, science and mathematics degree programs is critical. Most Indian students who start out in engineering majors are not retained. In 1983, when 18% of the total enrollees in engineering nationwide graduated, only 9% of the American Indian engineering enrollees were finishing the four-year program. The dropout rate of American Indians in engineering in New Mexico institutions is alarming. A survey of Indian enrollment at three New Mexico institutions (New Mexico State University (NMSU), University of New Mexico (UNM), and New Mexico Institute of Mining and Technology (Tech)) shows that in 1984, there were 58% fewer Indian engineering students in the junior and senior classes than in the freshman and sophomore classes. The percentage for NMSU is a much lower 33%, but this is still too high. Traditional retention programs, even those aimed particularly at minorities, have most often not proven successful with Indians. The critical situation challenges universities to try something different. Unless the Indian engineering dropout rate is reduced, the waste of potentially valuable scientific and technological leadership will continue.

Tribal members who are scientifically and technically trained and who retain the values of the tribe are vitally important to natural resource and economic development on reservations. Often tribes have hired non-Indians to make critical decisions in reservation resource development. However, tribes have become increasingly reluctant to continue this practice. The reason is that they find that when they must rely on individuals and corporations that do not share their values regarding land and natural resources, the tribes cannot effectively exercise control over development. Until a corps of professional Indian people is trained for tribal leadership in engineering, science, business and agriculture, neither the Indian tribes nor the nation will derive all the possible benefits of resource development on Indian reservations.

Indian Resource Development (IRD), headquartered at NMSU, along with the minority retention programs of the UNM and Tech, has devised a project to address the problem of retention of Indian students in technical majors. While most Indian retention programs have approached the problem through remediation, IRD proposes to attack it through training of college students in the skills of cognitive modifiability. Cognitive modifiability training is an innovative effort to overcome the difficulties in learning and produce capable scientific and technological personnel.

The theoretical basis of this intervention program and its original experimental application were developed by Dr. Reuven Feuerstein, Director of the Hadassah-Wizo-Canada Research Institute of Israel. The program, Instrumental Enrichment (IE), is designed to help adolescents who lack the trait of cognitive modifiability "increase the capacity ... to become modified through direct exposure to stimuli and experiences provided by the encounters with life events and with formal and informal learning opportunities."[1] American Indian students, like Feuerstein's subjects, are often raised between cultures, neither in the mainstream culture, nor in a traditional culture. When an integrated culture is not passed from generation to generation in the family, it is believed that certain cognitive qualities, such as analytical and comparative functions do not develop in the child. Inherent in the transmission of any culture is the subtle teaching of how to reason clearly. When children are on the margin of two cultures they have notable difficulty in thinking with precision. Feuerstein describes the syndrome of low cognitive modifiability this way: Some families live in "cultures of transition," where old values are not accepted but neither are the new values of the new culture they are moving into. These social disorganizations lead--even if there is no material poverty--to cultural deprivation. It is not a matter of any culture being deficient, but of the children being deprived of a culture. The parents, in conditions of cultural deprivation, do not act as agents of mediated learning.[2]

Feuerstein's theory is that the mediated learning experience is the basis for cognitive change: that is, the individual's ability to respond adaptively to a changing environment by using higher mental processes. In transmitting culture between generations, parents mediate a child's direct experience with the world by requiring the child to focus on certain stimuli and respond in specified ways. While transmitting the past and representing the future, the parent requires of the child abstract thinking, elaborated symbols, and higher mental processes. If this cultural transmission has been lacking in a child's upbringing, then he or she will not have the tools with which to attack new stimuli or adapt to a new environment; the child will lack cognitive modifiability.

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[1] Reuven Feuerstein, Instrumental Enrichment: An Intervention Program for Cognitive Modifiability (Baltimore: University Park Press, 1980), p. 115.

[2] Feuerstein, 1980, p. 339.

The analogies between the Israeli students in Feuerstein's studies and American Indian students are evident. Lifestyles of American Indians range from those families raised in the suburbs of Washington, D.C., to those living in very traditional pueblos. Many Indian families who live on the edges of the reservations or in large city ghettos don't accept and practice either the old ways or the new Anglo culture. A fragmented form of the culture is transmitted to the next generation. An analysis of Indians who are successful in highly demanding professions shows that they are almost evenly divided between having been raised by their grandparents in very traditional homes and having been raised in mainstream middle-class homes.[3]

The good news in Feuerstein's theory is that even though children may not have sufficiently developed cognitive functions, late adolescents or even older individuals can be taught cognitive change. Feuerstein has developed a set of exercises, Instrumental Enrichment (IE), to increase the individual's capacity for cognitive modifiability. The more than 500 pages of exercises are divided into 20 instruments. Each instrument is concerned with some aspect of cognitive structure, such as analytical perception, comparisons, orientation in space, categorization, or classification. Feuerstein notes that Instrumental Enrichment is content-free, and that the skills taught can be bridged to the content area that the teacher wishes to. IE will produce insights into cognitive functioning for the student which he or she can then apply to other areas--both academic and practical.

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[3] Susan Supernau. "Bridging Two Worlds: The Working Indian." Unpublished Manuscript, December, 1981. Albuquerque, NM.

In Feuerstein's original work in Israel he found that subjects who had receiving IE training scored higher on a test of general intelligence and on other achievement tests than control group subjects. Moreover, IE subjects scored significantly higher than controls on the intelligence test administered two years later upon the subjects' induction into the Israeli army.[4] In a systematic replication of Feuerstein's program undertaken on a population of culturally disadvantaged adolescents in a vocational school system in Ontario, Canada, the experimenters concluded that IE "can positively affect the cognitive development of academically low-functioning adolescents."[5] Staff of the NiHa'AlchiniBa Educational Programs in Shiprock, New Mexico, have results from use of IE in the curriculum of an alternative high school for Navajo students, and in two summer programs for groups of Indian high school students. Comparison of differences between pre- and post-test scores for an IE group and a comparison group shows IE provided superior training to that of the comparison group.[6]

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[4] Reuven Feuerstein, Ronald Miller, Mildred B. Hoffman, Yu'acov Rand, Yael Mintzker, and Mogens Reimer Jensen, "Cognitive Modifiability in Adolescents: Cognitive Structure and the Effects of Intervention," Journal of Special Education, 15, (1981), p. 285.

[5] Harvey Narrol, Harry Silverman, and Mary Waksman, "Developing Cognitive Potential in Vocational High School Students," Journal of Educational Research, 76 (1982), pp. 107-112.

The minority engineering programs at NMSU, UNM, and Tech participated, along with other universities in the Southwest in the National Association of Minorities in Engineering Program Administrators (NAMEPA) Region 6 Special Task Force on Indian Education in formulating the idea for and carrying out the American Indian Retention Program, a pilot project to be held in summer 1983 for one week to begin cognitive modification training with Indian students who had enrolled as freshmen in engineering or technical majors at one of the three New Mexico institutions, NMSU, UNM, or Tech. The National Action Council for Minorities in Engineering (NACME) provided seed money for the project that would give American Indian students cognitive training using Feuerstein's Instrumental Enrichment concepts. The goal was improved academic achievement and retention. This goal is measurable, and the project planners believe it is attainable.

Indian students who had enrolled as freshmen in engineering or technical majors at one of three New Mexico institutions, UNM, NMSU, and Tech were invited to participate. Twenty-one Indian students self-selected, eleven of whom were women. There were eleven Navajos, nine students from various Pueblos (San Felipe, Tesuque, Cochiti, Santa Ana and Laguna), and one Kiowa. The participants ranged in age from seventeen to twenty-four.

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[6] Letter received from Larry Emerson, Director, NiHa'AlchiniBa Educational Services, Shiprock, NM, 20 September 1984.

The basic purpose of the American Indian Retention Program was to introduce participating students to IE and provide them with training on several of the initial instruments. Substantively, this included diagnostic testing, cognitive development instruction, and evaluation of student progress. The seminar also featured intensive training in study skills and strategies for coping effectively with university life.

The Ravens Progressive Matrices test was administered at the beginning of the week to get a sense of the students' thinking ability. This test was chosen because it may correspond to the Feuerstein Structural Cognitive Modifiability theories in that the student must exercise "clear thinking" by using and calling into action a number of cognitive functions in order to solve the tasks. The mean score of the students was 51.3 out of 60. The males had a mean of 53.1, and the females one of 49.2. These scores put this group of students at the mean national percentile of 95%.

The instructors thus were challenged to refine the cognitive abilities of a group of bright, motivated students. The instructors assumed that even though the students demonstrated a high degree of cognitive efficiency, they still could use some instruction in basic concepts of comparisons, planning behavior, definition of problems, establishing of parameters of problems and solutions, analytical perceptions, and spatial orientation. So the instructors planned to provide some "basic training" in IE and to bridge to the Indian background of the students and to their proposed careers. Bridging is considered an essential component of IE, and the skill of the instructor in doing this is most important. Mr. Larry Emerson and Ms. Janet

Slowman, Navajo Indians and certified and experienced IE instructors, are very skilled in bridging.

Mr. Emerson began the week with a lecture on the theory of structural cognitive modifiability and the mediated learning experience as it relates to Indian education and Indian contemporary society. He pointed out that students could look at engineering as a process of thinking. A major assumption to begin with is that no culture is better than another with respect to development of thinking skills. Nevertheless, there are many young people today who are alienated from their Indian culture. But, Mr. Emerson pointed out, problems in cultural understanding can cause problems in one's cognitive abilities. Cognition and culture are related, and if one loses one's culture, one will lose other abilities as well. He said that learning to think enables the Indian student to discriminate, to pick and choose among the values of Indians and non-Indians. He noted that low self-concept has been identified as an educational obstacle among many Indian students. Thinking independently enhances one's self-esteem; the better one is able to handle information, the better one's self-concept. During the week ahead, he told the students, they would be able to slow down the thinking process; they would learn how to think about things. Being Indian, or being from a different cultural background, should not be impediments to being successful in college.[7] This lecture set the stage for the next week's Instrumental Enrichment instruction.

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[7] Perry Horse. "Evaluation Report: Indian Engineering Freshmen Seminar, August 7-12, 1983." Unpublished Manuscript, 1983. Albuquerque, NM. pp. 7-8.10

The IE classes were held twice a day for five days. The group of 21 students was divided in half, and two class sessions were held simultaneously led respectively by Mr. Emerson and Ms. Slowman. The modified Instrumental Enrichment classes consisted of drawn or written exercises, separated into instruments, each instrument stressing a fundamental concept. Unlike many traditional styles of instruction, the answers weren't hidden. Initially the strategies for doing well were discussed by the group. New ideas were elicited from the students. After individual work with the exercise, the concepts employed in the exercise were bridged back to other examples of academic work. Although the exercises got progressively more difficult, the students found them easier to complete because of the learning process.

For the week's classes the IE instructors chose three from among the 20 instruments developed by Feuerstein. They covered Organization of Dots, Comparisons, and Analytic Perception. The Organization of Dots instrument is an example. The task is to identify and outline, within an amorphous cloud of dots, a series of overlapping geometric figures. To complete the exercise successfully the students employed at least five different cognitive functions: visual transportation of the shape, scanning, reference to the model, projection of a relationship among otherwise discrete units, and holding an object constant despite the variations of its characteristics. The exercise demanded precision and accuracy from the students to identify parallel dimensions, distance, and size.

In the early exercises it was apparent that the students had the cognitive problems of lack of planning and proper strategizing, discriminating of task functions, and impulsiveness. In each subsequent exercise the students showed an improved performance and consciousness in planning, projecting relationships with precision and accuracy, and strategizing properly. Even though the exercises became progressively more complex, the number of mistakes made by the student decreased. This reflects a much more organized attempt by the student to define the task, to act on it, and to evaluate the work. In the American Indian Retention Program the instructors assisted students to bridge to their Indian culture and to their intended engineering careers using exercises especially designed for this project. For instance, one activity was a problem-solving exercise in which students were asked to identify and solve a problem in an Indian community by breaking the whole into parts and analyzing its structural and operational aspects. The students were also asked such questions as "How do you project relationships into seemingly unorganized activities in careers?" or "Where are precision and accuracy required of your performance in academic work?" or "On what occasions is planning necessary in getting a job?"

Five days is a very short period of instruction and can encompass only a small part of a program which is usually taught in daily sessions over two years. However, there was some attempt to measure the influence of the week's activities. The evaluator, Mr. Perry Horse, focused on student feedback as well as his own empirical observations of the program. During the last two days of the week he interviewed each student, and a final activity for the students was to respond to questionnaires rating the IE materials and assessing their own progress in improving their cognitive skills as a result of the IE instruction. A large majority of the students felt that the IE materials were beneficial. All of the students noted some change in their thinking behavior as a result of the IE instruction.

During the interviews each student was asked to rate himself/herself as a "thinker" on a scale of 1 to 10, 1=low, 10=high. A large majority, 17 out of 21 students, rated themselves between 5 and 10, with a median rating of 7. Some students indicated they would have rated themselves below 5 prior to the seminar; only four students rated themselves below 5 after the week-long session. The majority of the students reported that they found the seminar to be a rewarding, challenging experience.[8]

The instructors evaluated the students' progress through interpretation of the adapted IE materials. The instructors indicated that the students were highly receptive to modification of their thinking habits and skills. They noted particularly the students' improvements in precision and accuracy of thinking, their performance in handling tasks requiring them to manipulate many units of information at the same time (an efficiency of thinking task), their increased abilities to plan and organize, and their increased abilities to draw relationships between ideas and events across various parameters of thinking.[9] One Navajo student summed up his experience visually with symbols. [See Figure 1.] The first square was the student's mind before he started the seminar. In the second he had an idea of the process. In the third the idea became more precise and concentrated. There also were two sides in which to compare the similarities and differences. In the fourth square there was new information to fit into the mind. Finally, the fifth square concluded with an exchange of ideas.

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[8] Horse. pp. 7-8.

[9] Larry Emerson. "Interpretation of I.E. Program at New Mexico State University Freshman Indian Seminar, August 7-12, 1983." Unpublished Manuscript, 1983. NiHa'AlchiniBa Educational Services, Shiprock, NM, p. 3.

The evaluator of the American Indian Retention Program concluded "that the IE instruction and materials constitute an effective methodology for inducing cognitive development in high achieving young adults. However, further work and analysis are needed in order to confirm this general observation."[12] The program planners enthusiastically concur. Feuerstein has noted that "results of the PMA [Primary Mental Abilities] test suggest that Instrumental Enrichment exercises are particularly effective in improving numerical and figural concepts."[13] This indicates that IE is particularly well suited for cognitive training for those contemplating a technical career.

This summer program was the first of its kind in that it was directed specifically at the retention of Indian students in engineering and science through cognitive skills development. As such, it is a departure from the more conventional approach of academic remediation. However, this abbreviated version of IE instruction was too short to demonstrate the impact that is possible, and a longitudinal study with controls is needed to determine the long-term effects of increasing cognitive modifiability. The NAMEPA Task Force has submitted proposals to continue the project at the secondary school level to the National

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[12] Emerson. pp. 4-5.

[13] Feuerstein, 1980, p. 368.

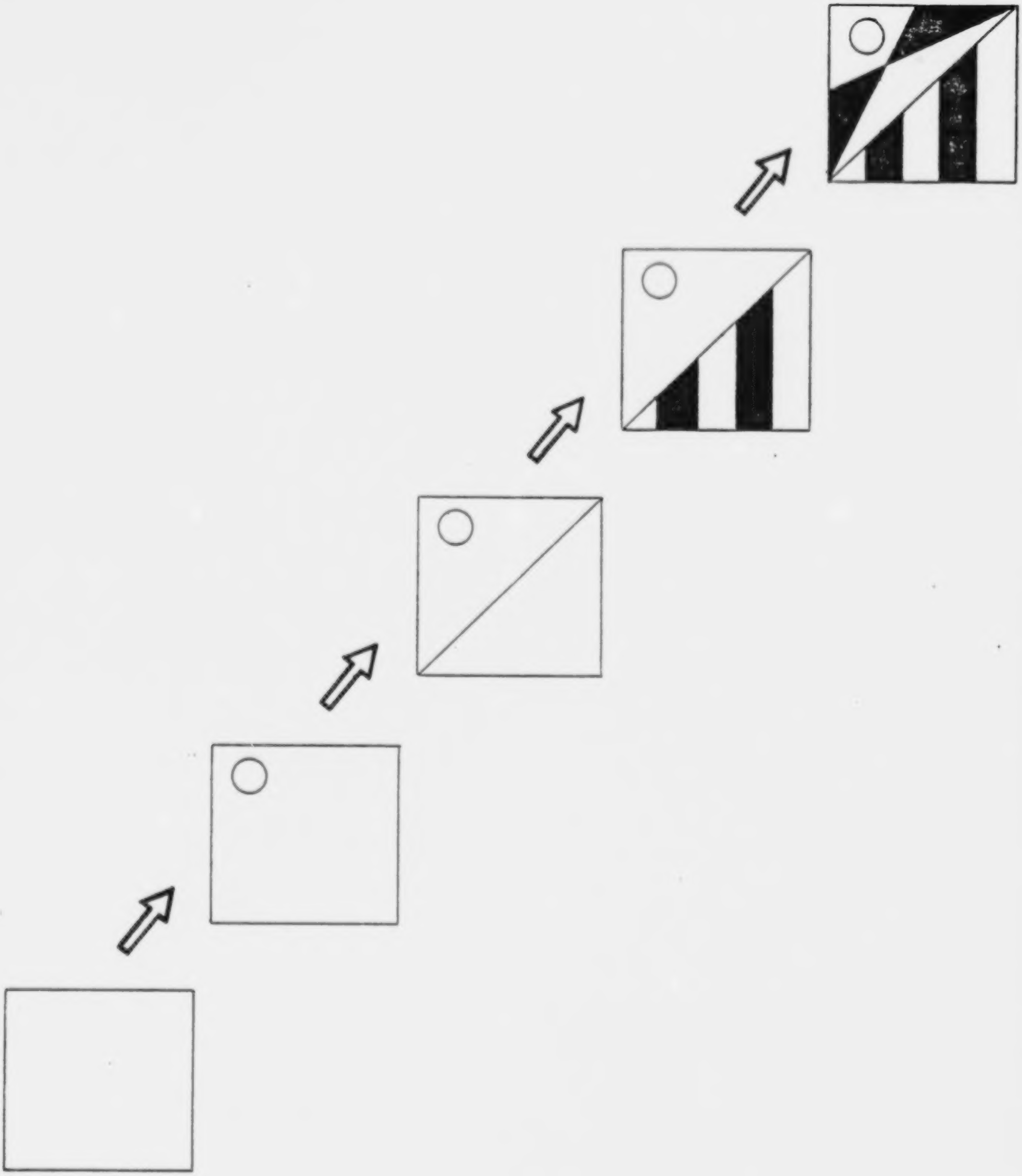

Figure 1

Science Foundation, and at the university level to the Fund for the Improvement of Post Secondary Education. Proposals are also being submitted to private foundations interested in sponsoring new ideas in technical education for minority engineering students.

TEACHING CRITICAL THINKING IN HIGHER EDUCATION

by

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INTRODUCTION

The report of the Study Group on the Conditions of Excellence in American Higher Education states (National Institute of Education,1984:35): "The Nation has entrusted its system of higher education to extend both the franchise of learning and the frontiers of the universe itself. But our students will find that this great national resource has not realized its full potential." Moreover, according to the report (1984:35): "many Americans are currently undereducated in relation to their potential." Why is it that we are not teaching to potential? Why is it that students are not learning to potential? What are the barriers that prevent us from realizing the full potential of higher education in American society?

While there are many areas of skill development worthy of consideration when evaluating a quality higher education, attention in this paper is specifically directed toward the *skill of critical thinking. In light of skill development generally and with particular focus on critical thinking, the NIE report recommends that postsecondary institutions be less grandiose in their statements of goals and far more specific about their objectives. The report states (1984:43):*

> *It is not sufficient that the lists generated by faculty and academic officers recite symbolic terms like "critical thinking," "problem solving," or "creativity." We recognize that not all of the outcomes of an undergraduate education can be specified in such a way as to be easily quantified. But this does not relieve us of the responsibility to define the knowledge, capacities, and skills we expect students to attain. For example, it is fair for a student to ask what we mean by "critical thinking," and it is fair to expect a faculty member to provide a satisfactory, detailed response."*

In this instance, the report is urging institutions of higher learning to make explicit their expectations of students to students, faculty members and the public. One of the more frequently mentioned skills necessary for a liberal education is the need to think critically. The NIE report states (1984:43):

> *Liberal education requirements should be expanded and reinvigorated to insure that (1) curricular content is*

> directly addressed not only to subject matter but also to the development of capacities of analysis, problem solving, communication, and synthesis, and (2) students and faculty integrate knowledge from various disciplines.

The report argues that education should prepare the individual to function in a changing world. In addition, that 'adaptation' to change requires the ability to (1984:43): "think critically, to synthesize large quantities of information, and to master the language skills (critical reading, effective composition, clear speech, and careful listening) that are the fuel of thought."

Although critical thinking has been prized from the time of the ancient Greeks, its importance as a needed skill comes and goes with the tide of academic movements. In a social climate of economic constraints, political pressures and academic uncertainty, institutions of higher education are re-evaluating their approaches to education. Not the least of concerns to many institutions is the assessment of modes of learning as they relate to what is considered 'a high quality education.'

During the last few years we have witnessed a growing concern about the critical thinking abilities of the students involved in higher education. To many observers in higher education, student abilities have seemed deficient--that is, below a standard deemed acceptable and achievable. Students appear, according to many faculty members, to enter with deficient thinking skills and, unfortunately, all too frequently graduate from our colleges and universities without necessary skills.

In addition, the task and responsibility of teaching in institutions of higher learning is frequently complicated and obstructed by the inability of many students to think critically. Deficiencies in basic thinking skills limit learning for students and impede the educational process generally.

Regarding the reality of deficiencies Zelda Gamson (1984) suggests that under the pressure of poorly prepared students and a dclining market of prospective college students, faculty and administrators have begun to re-evaluate their educational programs. Gamson states that by the middle of the 1970s inadequately prepared students began to infiltrate selective colleges and universities, causing a debilitating problem. It has taken a while for faculty and administrators to recognize the decline in student academic skills and even longer to begin to do something about it. Blame has been passed from shoulder to shoulder and several studies have confirmed that general education could be defined as a "disaster area" (Carnegie Foundation for the Advancement of Teaching, 1977). Although few faculty members know what specific skills their students should have, they become acutely aware of 'general' deficiencies in student quality. One obvious clue to the problem is the ever expanding discrepancy between the skills of the most capable and the least capable students. Gamson (1984) observed that few faculty know how to teach "skills." Many feel that teaching "skills" is the job of specialists, while they remain in specialized content areas.

Under a climate of despair, many faculty who once may have been idealistic teachers, find themselves denigrating students. Some faculty drift into a resigned acceptance of low student performance, inflated grades, sugar-coated assignments, and mutual boredom (Gamson, 1984). Other faculty, attempting to cling to and uphold standards of quality that they themselves met, find themselves stigmatized as extremely demanding, rigorous and unreasonable teachers.

There has been, however, a shift in perspective. Faculty members are slowly beginning to accept some responsibility for teaching basic skills--not only in open-door colleges but in others including the most selective as well (Shaughnessy, 1977; Richardson, Martens, and Fisk, 1981). Re-evaluation of *undergraduate education, that began in the 1970s, has re-emerged today. Debates regarding moving back to 'basics' or developing a core curriculum (Levine, 1978) have become common. Questions both of a practical and philosophical nature are discussed. Such as, "what should every educated person know?" "What skills are necessary to become a responsible citizen in a democracy?"*

As one listens to educators in Higher Education discuss critical thinking and as one reads about the subject, three impressions become clear. One is that teaching students to think critically is an objective shared by most teachers and is highly valued. The second is that there is not much consensus on what is meant by critical thinking. A third impression is that talk about critical thinking whether it be from the administration, faculty or students, far exceeds our knowledge about it and practice of it. In this case especially, talk is no substitute for action. Overall, it appears little is done directly in the classroom to improve students skills in critical thinking.

This paper will address the skills identified with critical thinking, deficiencies in thinking skills, and present recommendations for implementing critical thinking skills in higher education.

There are two dominant concepts of critical thinking held by educators. Educators have frequently defined critical thinking as a problem-solving process. This approach, most frequently associated with John Dewey (1933), is viewed as the discovery method. Dewey suggested that (1933:75): "actual thinking has its own logic, it is orderly, reasonable, reflective." Here the key for Dewey is the term 'reflective.' Coining the term "reflective thinking," Dewey identified five phases of this cognitive process (1933:107):

> (1) suggestions, in which the mind leaps forward to a possible solution;
> (2) an intellectualization of the difficulty or perplexity that has been felt (directly experienced) into a problem to be solved, a question for which the answer must be sought;
> (3) the use of one suggestion after another as a leading idea, of hypothesis to initiate and guide observation and other operations in collection of factual material;
> (4) the mental elaboration of the idea of supposition (reasoning, in the sense in which reasoning is a part, not the whole, of inference); and
> (5) testing the hypothesis by overt or imaginative action.

For Dewey, these five phases are not fixed sequentially therefore different problems will involve different patterns and contributions from these characteristics. Dewey's model has inspired and guided college teachers in their efforts to implement critical thinking in general education. The emphasis for Dewey is clear, critical thinking is a cognitive process that is closely aligned with the problem-solving process.

A second concept of critical thinking, other than the cognitive, problem-solving approach, holds that critical thinking is best identified as a form of logical analysis that results in evaluation. Max Black's influence is most significant in this area (1952). Supporters of this approach see critical thinking represented by such topics as deductive logic, induction, and language usage. Undoubtedly the most widely recognized development of this orientation is seen in the work of Robert Ennis. Ennis originally (1962:84) noted twelve aspects of critical thinking:

(1) Grasping the meaning of a statement:

Judging whether:

(2) there is ambiguity in a line of reasoning
(3) certain statements contradict each other
(4) a conclusion follows necessarily
(5) a statement is specific enough
(6) a statement is actually the application of a certain principle
(7) an observation statement is reliable
(8) an inductive conclusion is warranted
(9) the problem has been identified

(10) something is an assumption

(11) a definition is adequate

(12) a statement made by an alleged authority is acceptable.

While this list is not exhaustive, it does point the direction toward sophisticated thinking. In logical analysis, critical thinking is the correct assessing of statement, or correct evaluation.

Ennis' interpretation of critical thinking has been refined over the past twenty years. Ennis (1979:5-6) outlines characteristics of rational thinkers as persons who:

A. are proficient at:

(1) observing,

(2) inferring an explanation, the point, the meaning, and so forth,

(3) generalizing,

(4) conceiving and stating assumptions, alternatives, plans, predictions, definitions, and so forth,

(5) offering a well-organized and well-formulated line of reasoning,

(6) evaluating authoritative-sounding statements, deductive reasoning, inductive reasoning, explanations, value statements, and definitions,

(7) detecting standard problems and realizing appropriate action; and

B. have the tendency to:

(1) exercise the proficiency they possess,

(2) take into account the total situation,

(3) be well-informed,

(4) demand as much precision as the subject matter permits,

(5) deal with the parts of a complex situation in an orderly fashion,

(6) consider seriously other points of view than one's own,

(7) withhold judgment when the evidence and/or reasons are insufficient,

(8) take a position (and change the position) when the evidence and reasons are sufficient to warrant so doing, and

(9) accept the necessity of exercising informed judgments; and

C. exercise good judgment.

With the criteria of critical thinking stated above, one can see that for Ennis critical thinkers not only practice specific, technical, micro-logical skills but also demonstrate certain qualities of character and attitude.. In this view, critical thinkers are active, assertive participants in everyday reality.

The perspective advanced by Ennis extends the earlier work of Watson and Glaser (1964). Watson and Glaser share the perspective that critical thinking is a composite of attitudes, knowledge and skills. More expressly, attitudes of inquiry are accompanied by knowledge (e.g. rcognition of inferences, generalizations, abstractions, etc.) and integrated with skills in employing and applying the attitudes and knowledge. In this way, critical thinking enables the individual to assimilate, process and evaluate ideas.

Expanding this orientation of critical thinking one step further, Richard Paul (1984) suggests two distinct concepts of critical thinking skills: weak sense and strong sense skills. Weak sense critical thinking skills are viewed as (1984:5) "discrete micro-logical skills ultimately extrinsic to the character of the person; skills that can be tacked onto other learning." Strong sense critical thinking skills, on the other hand, are understood as "a set of integrated, macro-logical skills ultimately intrinsic to the charcacter of th person and to insight into one's own cognitive and affective processes." Paul argues that true teaching of critical thinking involves both sets of skills. Moreover, he holds the position that while short-term strategies may be beneficial in giving attention to micro-logical, analytic critical thinking skills, long-term strategies will depend more upon macro-logical skills. Ideally, for Paul, the teaching of critical thinking would include an integration and dialectical working of both sets of skills.

From the theorists reviewed above it is clear that there are two distinct concepts of critical thinking (problem-solving and logical analysis) and two levels of skills (weak sense, micro-logical and strong sense, macro-logical). If one is to teach critical thinking according to these guidelines, specific skills would be taught (e.g. observing, generalizing, evaluating, etc.) as well as an attempt to develop a certain quality of character and attitude. The quality of character and attitude implied if not explicitly stated for these theorists, is represented by a self-concept that accompanies the micro-logical skill development. This self-concept of a critical thinker is exemplified through such qualities self-confidence, self-reflection, self-consciousness and self-assertion. In addition, qualities such as intellectual openness, capable listening, inquisitiveness, an ability to recognize another's point of view and a willingness to participate in learning would be nurtured.

To illustrate these points, reference can be made to the process of asking questions in an educational setting. One particular view of critical thinking emphasizes the process of 'higher cognitive questioning' (Newton, 1978). Theorists of this perspective attempt to stimulate thinking through the use *of questions (Burton, 1929, 1960; Taba, 1967). There is little doubt that most educators would be pleased by a situation in which students were posing significant questions. Enhanced skills in critical thinking would aid this process in the following manner. Micro-logical skills would be necessary to form, in the cognition of students, reasonable and appropriate questions. In other words, is a statement incomplete, illogical, contradictory, tautological, etc., and therefore unacceptable? In addition to exibiting the cognitive ability to arrive at questions, it would be necessary for students to be listening to the statement, to be motivated to question, to have the disposition to inquire further, to know how to pose questions and to follow through by doing so. In this sense, critical thinking would include a certain quality of character and attitude for participating students. Inevitably, here the concern is not only with the ability to ask questions but also the educational context within which questions can be asked. Together, the micro-logical skills, the quality of character and a receptive educational environment work to foster critical thinking through questioning.*

DEFICIENCIES IN CRITICAL THINKING SKILLS

While many academicians share the educational goals that students should be able to think clearly, read critically, speak effectively, and participate competently, the reality of student capabilities generally falls far short of these objectives. As the National Institute of Education report (1984) has stated, "Many American are currently undereducated." Deficiencies in thinking skills represent one important area of 'undereducation.' But what, specifically, are deficiencies in thinking skills?

Any failure in utilizing mental potential that is expected within a certain environment may be considered a deficiency in thinking. To be deficient is to be below a standard deemed acceptable and achievable within a particular context. The NIE report, results from standardized tests (SAT, ACT, GRE), institutionally conducted testing and faculty testing all reveal critical thinking deficiencies in the student population. As the definition of deficiency implies, two possible ways of overcoming deficiencies are to either lower standards or increase the skills learned. Obviously, most academics support the latter option. Educators prefer to improve the critical thinking capabilities of their students, rather than to lower their standards. The key, then, is how to improve the critical thinking skills for a large number of students.

One of the steps necessary to overcome deficiencies in critical thinking is first to be able to recognize deficiencies when they exist. Micro-logical thinking deficiencies may be considered those of a cognitive nature. The inability *to detect a problem, define a situation, formulate hypotheses, question an assumption, analyze a situation, recognize a contradiction, integrate ideas, draw a conclusion, infer an explanation, and/or consider alternative possibilities are all examples of micro-logical thinking deficiencies.*

At the macro-logical level of deficiencies (Paul, 1984), students may be intolerant, unreflective, unmotivated, incapable of listening, unable to assume other points of view, and/or non-inquisitive. They may be egocentric and/or sociocentric (Paul, 1984). A narrowmindedness prevails, frequently academic content becomes reduced to a personal interpretation absent of a social consciousness. Deficiencies at the macro-logical level may also include attitudinal factors. A depreciation of edcuation, low motivation, and a strict non-participatory stance may be demonstrated. Obviously, the combination of limited technical thinking skills at the micro level accompanied by deficient quality of character at the macro level forms a reality that makes high quality learning and teaching extremely difficult.

In addition to the deficiencies mentioned, consideration should be given to the contextual environment of education. Deficiencies in critical thinking skills are often perpetuated by structural factors such as large class sizes and high *teaching loads. In certain situations faculty may work in an educational context that places a high value for professional development and relatively low actual (rewarded) value on teaching. Moreover, many faculty may find that their educational training did not adequately prepare them to recognize and test thinking skills or deficiencies in thinking. Likewise, their educational background may not have included knowledge regarding the teaching of critical thinking skills. In short, even if faculty recognize a problem with thinking skills, they may feel illequiped to deal with the problem.*

Recognition of the importance of critical thinking skills and an awareness of deficiencies in such skills has also been expressed by prospective employers of college graduates. Watts and Johnson (1984) asked employers what types of college skills they expect a graduate to have gained from a college education. Their findings indicate that (1984:190): "the most frequently expected skills were writing (80.9%), initiative (69.9%) and critical thinking (69.4%). According to Watts and Johnson (1984:199) employers "want students who can think critically about the practical issues that face an industry or business." Deficiencies in critical thinking appear to impede the functioning and improvement of business.

One final point of recognition is important when discussing deficiencies in critical thinking. Many educators still hold to the idea that critical thinking is learned automatically when certain subjects (mostly social sciences and math) are studied, and therefore it need not be formally considered. Glaser's pioneering literature (1941:69-70) is still the best response to this point of view:

> There is no evidence that students acquire skill in critical thinking as a necessary by-product of the study of any given subject. On the other hand, almost any subject or project can be so taught as to put pupils on guard against hasty generalizations, contradictory assertions, and uncritical acceptance of authority. In general the research indicates that if the objective is to develop in pupils an attitude of "reasonableness" and regard for the weight of evidence and to develop ability to think critically about controversial problems, then the component attitudes and abilities involved in thinking critically about such problems must be set up as definite goals of instruction.

Over forty years has passed since Glaser's original statements and yet the report from the National Institute of Education is highlighting identical concerns in higher education. Both Glaser's work and the NIE report call for specific attention to be directed toward deficiencies in *thinking and the prospect of teaching critical thinking skills.*

When considering the quality of higher education today and when pointing toward the future, deficiencies in critical thinking deserve attention. Responsibility for deficiencies in critical thinking rests on the shoulders of students who must overcome thinking deficiencies, faculty who must re-evaluate their courses in light of critical thinking, and administrators who must encourage both a structure and process for critical thinking.

RECOMMENDATIONS FOR IMPLEMENTING CRITICAL THINKING IN HIGHER EDUCATION

There are numerous methods that could be employed to improve the learning and teaching of critical thinking skills in higher education. One of the most important steps would be to sophisticate the data (student outcomes) indicating student skills and deficiencies. In this regard the NIE report states (1984:45): "Faculty and academic deans should design and implement a systematic program to assess the knowledge, capacities, and skills developed in students by academic and cocurricular programs." Adequate measures of thinking skills for students upon entering higher education, during their education and at the conclusion of their education are *essential if we are to work toward improving student performance and the quality of education generally.*

A specific recommendation is to effectively employ computer technology in improving the critical thinking of students. Computer technology may be utilized to teach micro-logical thinking skills, to foster student participation in learning, to collect data on student performance and to create programs that challenge and advance thinking skills. In addition to the prospect of the computer teaching critical thinking, it is equally reasonable to expect that critical thinking could be used to scrutinize the computer as a relatively recent social and technological phenomenon.

In line with the NIE report (1984), liberal education requirements should be expanded and reinvigorated to include not only the learning of subject matter but also the capacity of critical thinking. Learning the skills of critical thinking provides students with the technical tools necessary and the character required to function in a rapidly changing society.

The NIE report (1984) as well as numerous other commentaries have voiced the opinion that we should expect more from our students. Increasing standards of performance for students, providing means for overcoming deficiences in thinking and sophisticating critical thinking skills are all important considerations if we are to improve the quality of higher education.

Institutions of higher education should establish opportunities for both faculty and students to increase their knowledge of critical thinking. Courses, workshops, computer training, exercises, instruments, and references should all be made available for use. It would be beneficial for faculty to identify the critical thinking that is going on presently in their classes and seek means of advancing the teaching and learning of critical thinking in their courses.

Faculty should consider developing specific methods to facilitate the teaching of micro-logical critical thinking skills within their established subject areas. Educators may find a fresh look at their courses to be advantageous for improving the structure and process of their classes.

Faculty may be encouraged to participate in critical thinking as it relates to their discipline. The professional advancement of "theory" and "research" on critical thinking has relevance for most if not all disciplines. Critical thinking as an area of study would benefit from educators in various disciplines relating critical thinking to their subject matter. In addition, educators would benefit by sharing ideas, methods, data and literature relevant to critical thinking.

Administrators, faculty members and students should work to establish educational structures that encourage critical thinking. Students should be rewarded for their demonstration of critical thinking skills, faculty should be rewarded for their efforts to teach critical thinking, and administrators should be rewarded for their leadership in providing structures and incentives that enables critical thinking to flourish.

Perhaps the most important recommendation that can be suggested is for those concerned about higher education and its future to recognize and appreciate the skill of critical thinking and to begin to play a part in advancing its contribution to education. When more educators take part in this endeavor, then we will have moved one step closer to realizing the full potential of higher education in American society.

References

Black, M. (1952) Critical Thinking. Englewood Cliffs, N.J.:Prentice-Hall.

Burton, W.H. (1929) The Nature and Direction of Learning. New York: D. Appleton.

______, Kimball R. and Richard Wing, (1960) Education for Effective Thinking. New York: Appleton-Century-Crofts.

Carnegie Foundation for the Advancement of Teaching, The. (1977) Missions of the College Curriculum: a Contemporary Review with Suggestions. San Francisco:Jossey-Bass.

Dewey, J. (1933) How We Think. Lexington, M.A.:D.C. Heath.

Ennis, R. (1979) "Logic, Rational Thinking, and Education," Philosophy of Education 1979:Proceedings of the Thirty-Fifth Annual Meeting of the Philosophy of Education Society Jerrod Coombs (ed.) Philosophy of Education Society.

______(1962) "A Concept of Critical Thinking," Harvard Educ. Rev. 32:81-111.

Gamson, Z.F. and Associates, (1984) Liberating Education. San Francisco: Jossey-Bass.

Glaser, E. (1941) An Experiment in the Development of Critical Thinking. New York:Teachers College, Columbia University.

Levine, A. (1978) Handbook on Undergraduate Curriculum: Prepared for the Carnegie Council on Policy Studies in Higher Education. San Francisco:Jossey-Bass.

National Institute of Education, (1984) "Text of New Report on Excellence in Undergraduate Education," The Chronicle of Higher Education, Oct. pp.35-49.

Newton, B.T. (1978) "Theoretical Bases for Higher cognitive Questioning--An Avenue to Critical Thinking," Education, Vol. 98(3):286-291.

Paul, R. (1984) "Critical Thinking: Fundamental to Education for a Free Society," Educational Leadership, Sept. pp.4-14.

Richardson, C. Jr., Martens and Fisk (1981) Functional Literacy in the College Setting. AAHE-ERIC Higher Education Research Report No. 3, Washington, D.C.: American Association for Higher Education.

Shaughnessy, M. (1977) Errors and Expectations. New York: Oxford University Press.

Taba, H. (1967) Teachers Handbook for Elementary Social Studies. Reading, Mass.:Addison-Wesley.

Watson, G. and E. Glaser (1964) Watson-Glaser Critical Thinking Appraisal. New York:Harcourt, Brace and World, Inc.

Watts, W.D. and R. Johnson III, (1984) "Employability of Sociology Graduates, 1982," Teaching Sociology, Vol. 11(2), Jan. pp.183-204.

WORKING WITH NON-TRADITIONAL STUDENTS:
WOMEN IN TRANSITION

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INTRODUCTION

Colleges and universities have long been considered institutions for youth. They are viewed as logical extensions of the progression from grade school to junior high school, from high school to college. As all inclusive as this progression sounds, many students are left stranded by the side of the road. The educational process loses students at almost every major intersection. Some drop out between junior high and high school and some finish high school and do not seek further education for reasons ranging from personal burnout to financial hardships. Others are fortunate enough to continue through college and may even seek post-graduate degrees. A rising phenomenon of our current educational process is that many who drop out seek re-entry later in their lives, returning to the system with added age, maturity, experiences--and greater expectations. Often these re-entry students are viewed, both by traditional students and faculty, as highly exceptional intruders on the domain of youth. Many institutions and educators have looked on this population and its educational requirements as marginal activity. Adults do not always fit easily or comfortably into this youth-oriented world. Colleges and universities seem to have an equally difficult adjustment when these adults become students.

Adults who do not have degrees are returning to the campus in record numbers in search of more education. (Carnegie Report, 1981) Nationally, over one-third of all students taking college credit-bearing courses are over the age of 25 (Margarrel, 1981). Slightly more than 52% of all college undergraduate students (of whatever age) are now women. (Hodgkinson, 1983) Yet, it has been estimated that only fourteen percent of Americans over the age of 25 have college degrees, making this a largely untapped market for future growth for colleges and universities as they are facing the realities of a stable or perhaps even a decreasing traditional aged population.

Ernest Boyer (1981) of the Carnegie Foundation for the Advancement of Teaching indicates that for as far into the future as can be projected, the shape of American education is going to reflect older students' participation. He believes that this is perhaps the most significant shift in college population forecast since the baby boom expansion of the 1960's and that the impact of this new movement of older students is just beginning to be felt. (Carnegie Report, 1981)

WHO IS RETURNING AND WHY THEY RETURN

When viewing this adult student body, one must consider the population and its educational needs as a group. Just as with traditional students, many adults' needs are similar and require common responsive measures. Although re-entry students come from a variety of ethnic backgrounds, financial abilities, and educational histories, they share many of the common problems of re-entry. This process can mean a disruption of former lifestyles and new, unfamiliar, challenging experiences that may bring with them emotional as well as educational perplexities.

Studies suggest that between one-in-three and one-in-five adults are currently involved in educational pursuits of one type or another. (Axford, 1980; Cross, 1982; Harrington, 1977; Heppner, 1982; Title, 1982) There seem to be several common indicators characteristic of adults engaging in re-entry learning.

I. PAST LEVEL OF EDUCATIONAL ATTAINMENT

Cross (1980) suggests that the past level of educational attainment may well be the single most important predicator of whether or not a person seeks re-entry. According to Cross, individuals who have graduated from high school will find themselves four times more likely to become involved in higher education than non-high school graduates. Future implications for colleges and universities are revealed in the projection that the general population of the United States is becoming better educated with each passing generation. The average adult over the age of 25 in 1980 had 12.3 years of schooling as compared with 9.3 years just one generation ago. (Gross, 1982; Golladay, 1976) Thus, it would seem that the rising educational attainment of the general population may well result in an increased demand for more learning activities by older students. The real numbers of adults seeking admission to universities and colleges also seems to project this trend. (See Table I)

TABLE I

Projections Show Increase in Enrollment of Older Students by 1990

Age group	Estimated enrollment in 1970	Proportion of population in 1970	Projected population in 1990	Projected enrollment in 1990	5-year change
14 through 17	311,000	1.9%	12,770,000	243,000	- 68,000
18 and 19	2,844,000	34.6%	7,195,000	2,489,000	-355,000
20 and 21	2,353,000	29.1%	7,311,000	2,128,000	-225,000
22 through 24	1,794,000	15.4%	10,641,000	1,639,000	-155,000
Total, 14 through 24	7,302,000	16.6%	37,917,000	6,499,000	-803,000
25 through 29	1,679,000	9.3%	20,169,000	1,876,000	+197,000
30 through 34	996,000	6.1%	20,917,000	1,276,000	+280,000
35 through 39	566,000	4.2%	19,261,000	809,000	+243,000
40 through 44	330,000	2.9%	17,331,000	503,000	+173,000
45 through 49	223,000	2.0%	13,889,000	278,000	+ 55,000
50 through 54	139,000	1.2%	11,442,000	137,000	- 2,000
55 through 64	111,000	0.5%	20,776,000	104,000	- 7,000
Total, 25 through 64	4,044,000	3.2%	123,765,000	4,983,000	+939,000
Total, 14 through 64	11,346,000	7.7%	161,682,000	11,482,000	+136,000

Source: The Chronicle of Higher Education, May 4, 1981

These projected enrollment trends of older students become even more significant when viewed alongside the historical projection of five-year enrollment trends of older students. (See Tables I and II)

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TABLE II

5-Year Enrollment Trends Among Older Students

Population aged 25 through 34

	1979			Change from 1974		
	Men	Women	Total	Men	Women	Total
Total	16,715,000	17,674,000	34,389,000	+18.3%	+17.2%	+17.7%
In college	1,356,000	1,319,000	2,675,000	- 1.1%	+58.7%	+21.5%
Full time	558,000	364,000	920,000	- 0.7%	+41.6%	+12.5%
Part time	798,000	955,000	1,755,000	- 1.4%	+66.4%	+26.8%
Freshmen	160,000	281,000	441,000	-15.8%	+59.7%	+20.5%
Sophomores	193,000	212,000	405,000	-18.2%	+86.0%	+15.7%
Juniors	203,000	146,000	349,000	+19.4%	+43.1%	+28.3%
Seniors	193,000	138,000	331,000	- 7.7%	+84.0%	+16.5%
Graduates	606,000	543,000	1,149,000	+ 6.9%	+48.8%	+23.3%
2-year colleges	288,000	375,000	664,000	-16.5%	+70.5%	+17.5%
Full time	102,000	81,000	185,000	+ 3.0%	+52.8%	+21.7%
Part time	186,000	294,000	479,000	-24.4%	+76.0%	+16.0%
4-year colleges	460,000	402,000	862,000	0.0%	+62.8%	+21.9%
Full time	203,000	136,000	340,000	-14.0%	+33.3%	+ 1.2%
Part time	257,000	266,000	522,000	+14.7%	+83.4%	+40.7%

Population aged 35 and over

	1979			Change from 1974		
	Men	Women	Total	Men	Women	Total
Total	42,437,000	49,427,000	91,864,000	+ 6.5%	+ 6.6%	+ 6.6%
In college	487,000	914,000	1,402,000	+ 2.3%	+66.8%	+36.8%
Full time*	81,000	147,000	228,000	-22.9%	+42.7%	+ 9.1%
Part time*	402,000	764,000	1,166,000	+ 9.2%	+72.5%	+43.8%

*Full-time or part-time status was not indicated by 0.6 per cent of the students.

Source: The Chronicle of Higher Education, May 4, 1981

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II. THE CHANGING ROLE OF WOMEN IN OUR SOCIETY

Women are returning to education as an increasing force and in ever-increasing numbers. One of the fastest growing student groups on college and university campuses are women 35 and over. (Cross, 1980; Naisbitt, 1982) In 1972, 418,000 women in this age group were in college. By 1976 this figure had grown to 700,000 an increase of 67%. This growth has continued at an increasing rate of participation. During the same period the enrollment of male students 35 and older grew from 365,000 to 489,000--an increase of only 34 percent. (Feeney, 1972; Apps, 1980) Between the years 1969 and 1975 the number of adult women learners has increased by 45 percent as compared to an 18 percent increase for men. (Cross, 1980) Naisbitt's *Megatrends* (1982) calls this new role for women the "option explosion" and he projects that the new options have significant implications for colleges and universities simply because of the projected numbers. There are now more women in college and graduate schools than men and the majority of these "new" college women are over the age of 35. This significant increase for female participants is due to a number of factors.

Historically there has been a continually increasing participation rate for women in education. A review by Feeney (1972) shows that, although progress has been continuous, it has been sometimes slow, and is still influenced by many of the same cultural and personal barriers that seem to have existed previously. According to Feeney, a complex set of social and personal forces bring women back to education:

1. Increased prosperity of the general population.
2. A re-evaluation of women's educational needs.
3. Expanding leisure time especially among middle-aged and elderly women.
4. Civil Rights Issues and the institutional need to comply with the law in admitting more women.
5. Women's need for education for teaching and technical jobs.
6. Higher status of women leading to social acceptability of women enhancing their knowledge.
7. Acceptance of modern psychological theories leading to self actualization through education.
8. Changing life patterns of women especially when considering the higher divorce rate and current trends of re-entry into the workplace and/or school.
9. Increased emphasis on the need for continuing education owing to the expansion of knowledge.
10. Enjoyment of learning.
11. Desire for professional growth.
12. Feelings of discontent and the need for change.
13. Sense of inadequacy with previous levels of education.
14. Changing aspirations of women themselves.

One or all of these factors may be involved in the decision to re-enter. But Feeney suggests that women are primarily returning in large measure because the women's movement has granted acceptability for women to become re-involved in education.

There are several characteristics of returning women students that are important for administrators and those in policy-making position. Age is certainly one of the most important characteristics for re-entry women, but others that may be equally important are marital status, number and ages of children, length of time since the last educational or work experience, and personal statements concerning the reasons for returning to higher education. Title and Denker (1980) suggest there are several factors which also act as preventative forces for mature women re-entering the educational system. These barriers have been categorized as institutional, situational, and dispositional.

Institutional factors that have excluded women from post-secondary education include sex and age quotas, financial aid practices, regulations, deficiencies in curriculum planning, insufficient student personnel services, and faculty and staff attitudes. The more serious institutional barriers are in the form of discrimination against part-time students and a virtual lack of financial support for the part-time student. Institutional practices concerning course offerings may make little or no effort at becoming flexible, i.e., there seem to be few attempts to systematically examine scheduling and course cycles over time in order to provide availability for the part-time student. Time limits on course or degree requirements are often a hindrance to the returning part-time student as are the schedules and the locations of the courses. Most typically. institutions may limit access to resources and support facilities for part-time students. This is particularly true of evening students. Offices of counseling, career planning and placement, advisement, financial aid, book stores, and some libraries are often open at hours scheduled for staff, rather than for student, convenience. (Title and Denker, 1980)

Situational or social barriers are those likely to arise from the social class and ethnic or racial group to which the returning woman belongs. Fewer women from lower socioeconomic groups are likely to participate in post-secondary education. (Cross, 1980) With the exception of black women, the college attendance rate of minority women is under that of males of all ethnic groups and of white females. There seems to be lower expectations for women, in general, and for women of minority groups specifically, to continue their educations. (Title and Denker, 1980)

III. THE CHANGING RACIAL AND ETHNIC DEMOGRAPHY OF HIGHER EDUCATION

Hodgkinson (1983) overviews the demography of students in the 1980's and 1990's. Birthrates in the U.S. remained a "Baby Boom" high between 1946 and 1964 followed by a period of decline then rough stability or gentle incline after 1979. The "Baby Boom" age cohorts are now adults who are producing another demographic crest by 1998 with their own offspring and are themselves becoming the new generations of re-entry students.

While this fairly describes the national trend, it masks very distinct differences between various demographic sectors. The birth rate decline since 1964 was primarily among the white, middle class while birth rates for most minority groups remained constant, resulting in increased percentages of minorities among birth cohorts. As Table III indicates, these minority cohorts are heavily enrolling in the public schools, the educational institution for approximately 90% of the nation's elementary and secondary students. (Hodgkinson, 1983) It is in higher education's best interests, then, to assure that increasing high school attrition is reversed and that these minority students do well in public school and thus become college eligible especially in states with high minority enrollments. And, since 90% of the 1990 work force is at work today, the 10% added should represent a higher proportion of minority youth if they are educationally prepared to compete alongside their white peers. By 1990, minorities of all ages will constitute 20-25% of the total population, while their percentage among the youth cohorts will be over 30%. (Hodgkinson, 1983) This pattern is unfolding even faster in the sunbelt states where the numbers of high school graduates is already stabilizing or increasing due both to increases in fertility and immigration.

By 1990, it is anticipated that 19% of Americans will live in the West and 31% in the South as the population continues to shift to these areas creating very different problems for the expanding Sun Belt institutions in contrast to the declining Frost Belt institutions. Still, significant differences between minority groups exist. Currently, 28% of all black youth between 18 and 24 enter college but Hispanics enter at a rate between 5-15% for the same cohort. However, in contrast to previous generations of Hispanics, only 65% of 5-17 year old Hispanics speak Spanish and all but 16% speak English making these growing cohorts more likely to acquire sufficient bilingual skills to compete in English speaking college campuses. (Hodgkinson, 1983) Yet, there are regional differences among the various Hispanic subpopulations which may require different strategies of institutional response for each subgroup.

TABLE III

MINORITY PUBLIC SCHOOL ENROLLMENT
FALL 1980

State and Region	% of Total Enrollment	State and Region	% of Total Enrollment
United States	26.7	*Southeast*	
		Alabama	33.6
New England		Arkansas	23.5
Connecticut	17.0	Florida	32.2
Maine	0.9	Georgia	34.3
Massachusetts	10.7	Kentucky	9.1
New Hampshire	1.3	Louisiana	43.4
Rhode Island	8.2	Mississippi	51.6
Vermont	1.0	North Carolina	31.9
		South Carolina	43.5
Mideast		Tennessee	24.5
Delaware	28.8	Virginia	27.5
District of Col	96.4	West Virginia	4.3
Maryland	33.5		
New Jersey	28.4	*Southwest*	
New York	32.0	Arizona	33.7
Pennsylvania	14.9	New Mexico	57.0
		Oklahoma	20.8
Great Lakes		Texas	45.9
Illinois	28.6		
Indiana	12.0	*Rocky Mountain*	
Michigan	21.3	Colorado	22.1
Ohio	14.7	Idaho	8.2
Wisconsin	9.3	Montana	12.1
		Utah	7.3
Plains		Wyoming	7.5
Iowa	4.1		
Kansas	12.7	*Far West*	
Minnesota	5.9	California	42.9
Missouri	14.8	Nevada	18.9
Nebraska	10.5	Oregon	8.5
North Dakota	3.5	Washington	14.1
South Dakota	7.9	Alaska	28.4
		Hawaii	75.2

SOURCE. These data were presented at a conference sponsored by the Institute for Educational Leadership, November, 1982. (Hodgkinson, 1983)

IV. THE PROCESS OF ACTIVELY RECRUITING ADULT LEARNERS

More and more universities seem to be becoming aware that the adult age group has the largest potential for growth in the 1980's and beyond, possibly into the year 2000. (See Table I)) Some changes in methods would seem appropriate for colleges to meet the needs of this group of adult learners. Since the early 70's it has become somewhat easier for the re-entry student, who must work days, for example, to get a degree. Many colleges that previously offered only non-credit, continuing-education courses have developed a full night curriculum. Other schools with limited

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programs have expanded them. Most would indicate the reason is at least partly economic.

Colleges and universities are discovering the power of actively advertising for this population. Directed, specific recruitment seems to meet the needs of a population in search of retraining and may also help universities face the realities of a now stable or decreasing traditional population pool.

Universities and colleges are using newspapers, television, and radio advertisements in an attempt to reach and attract from this population. This seems to be particularly true of community colleges and colleges that have been designed specifically to meet the needs of this age group, such as City University, Antioch College, British Open University and the University of Mid-America.

The scheduling of more and more classes during the evening hours and at places and times more convenient to an older, off-campus population speaks to an awareness of the need to make education more accessible to this group. Ferguson (1980) suggests that for too long schools have been entrenched bureaucracies whose practitioners have not had to compete for business nor have they had to stand for reelection or "attract patients, customers or clients." According to Ferguson, in an era of decreasing traditional population, the ability to recruit and attract new and different populations may be the most dynamic area for growth and, indeed, even obligatory for institutional survival.

There is some criticism of the process of active, aggressive recruitment of adult learners. Traditional educators seem to believe that the recruitment of adults into traditional educational programs will result ultimately in the spread of lockstep schooling and the development of an over-credentialed society. Another reoccuring criticism is that in their eagerness to recruit adult learners, universities are engaging in "academic hucksterism" and the selling of credentials through liberal policies of conferring credits which compromise academic standards. There is also a growing suspicion that colleges are more interested in meeting their own needs for survival by the recruitment of adults than in serving the learning needs of the adult student once they have been recruited. (Cross, 1982) Universities will have to face critical examination of their individual recruitment programs to insure that these programs are not solely aimed at promoting the survival of the institution, but at the improvement of adult learning opportunities.

The recruitment of adult students is occurring not only by colleges and univsities who currently are attracting about 12 million people, or 1/4 of adult learners. The other 3/4 or 46 million adults are being educated by such diverse sponsors as union colleges, corporation training schools, the military and the U.S. Department of Agriculture. (Hodgkinson, 1983) Colleges and universities could and perhaps should attempt recovery of some of these 46 million people into their institutions and reverse the growth of this "second system" of postsecondary education.

Adding to the recruitment strategy will need to be a growing recognition of the marital, parental and occupational histories of prospective students. While in 1950, 65% of the households had a working father, homemaker mother, and two or more school age children, that description currently only fits 17% of households, reflecting both higher divorce rates and higher work force participation rates for women. (Hodgkinson, 1983) Almost half of all children being born in the 1980's will be raised by a single parent for at least part of their lives. The exact influence of these demographic trends is unknown but these younger cohorts may not be an intensely home educated by parents who are busy working and possibly being students themselves which may influence their attitude and preparation for college work in the future. In addition, the rapid growth of adults 65 and older creates an additional market if their educational needs and financial means can be effectively determined and met by educational institutions.

SOCIOECONOMIC STATUS OF ADULT LEARNERS

The history of our changing population structure yields evidence as to who is and will be available for re-entry education. Apps (1980) has compiled statistics that show the implications for education of this changing structure of the adult population. The median age of the United States population is slowly creeping higher. In 1975 it was 28.8; in 1980, the median age was 30.2; and in 1990 it is projected at 32.8. The number of people in the 24-and-younger age group is declining and those in the 26-64 age groups are increasing. In 1975, 93.9 million people were 24 or younger; by 1990 predictions indicate a drop to 89.9 million in this age group. In 1975, 97.3 million people were 25-64. Predictions for 1990 show 123.8 million in this age group with an added increase for those over 65 from 22.4 million to 29.8 million. (Apps, 1980)

There are some disturbing characteristics to be found in the overall socioeconomic status of adult involvement in higher education. Adult education, from all reported trends, appears to be elitist and is getting more so. As a group, today's adult learners are disproportionately white, well-educated and make good salaries. Certain populations are significantly under-represented in organized learning activities for adults: racial minorities, including blacks; people with less than a high school education; those whose annual family income is under $8,000; people 45 and older; and those living in the central cities or on farms. (Cross, 1980)

The greatest increase in education participation between 1969-1975 was by white women with a college degree and family incomes of $25,000 or more. (Cross, 1980) The rate of growth for women is double the rate of growth for men, the rate of participation for college graduates is twice that of high school graduates and the participation of whites has increased eight times in proportion to blacks and other minorities.

INSTITUTIONAL RESPONSES

Hardly a college or university has failed to feel the impact of adults returning to campus and few have failed to adapt in some way to this new, older student on campus. The nature and the types of adaptations, however, vary from campus to campus and are tied to a complex series of pressures applied as the campus slowly takes on a delightful shade of grey. Ackell (1982) has defined three stages of adaptation:

STAGE ONE:

The Laissez-Faire Stage - This stage is characterized by a simple removal of any barriers or artificial constraints on adults. (i.e.. age requirements, parental consent forms, sex or racial requirements, and an easing of the requirements of years in and out of college.)

This system allows adults access to do the best they can within a system that works neither for nor against them. Adults are allowed to be as entrepreneurial and aggressive as they wish in dealing with the institution, according to Ackell. In the Laissez-Faire stage institutions tend to lack provisions for adult students, i.e.,

--No active recruitment
--No special support services
--No curriculum development efforts especially for adults
--No faculty development efforts for dealing with adults

Ackell suggests that there is an overall institutional assumption that student problems are intrinsic to their role as students, not their age, maturity, and/or experiences.

STAGE TWO:

The Separatist Stage in which institutions, when faced with an increased and increasing enrollment of adult students, soon realize that age is relevant to student needs. Adults are essentially segregated from the major student body and given separate specially developed programs, usually at different times and locations from the traditional student body and often with a lack of effective

Ackell suggests that these programs are also given a priority and status demonstrably lower than those of traditional programs. Adults become exploited economically and sometimes educationally as well. Fees are not adjusted, the services are weak, if available at all, and there is usually substantially less general fund support than that given to programs for younger students. Other characteristics of this stage include:

- --A clearly segregated and identified adult or evening program.
- --A separate or part-time faculty for this evening unit consisting primarily of adjunct or part-time faculty and some regular faculty.
- --Limited or tightly controlled opportunities for evening students to take day classes and for day students to take evening classes.
- --Different programs and degree requirements for day or regular programs and evening or adult programs.
- --Separated and different services for adults.
- --Limited noninstructional student services for adults.
- --Low status for administrators of adult programs granting them limited or no access to university policy-making processes.

STAGE THREE:

The Equity Stage has characteristics are the following:

- --Active recruitment of adult students.
- --Appropriate delivery systems for adult learning.
- --Fully integrated curriculum.
- --Fully integrated faculty.
- --Provisions for degree credits for prior learning.
- --Administrative service made available by phone, mail, during the evening, and on weekends.
- --Academic advising available at hours adults are on campus.
- --Personal counseling, financial advising, career counseling, and other student support services available in the evening and responsive to adult problems.
- --Senior policy-making bodies of the university aware of adult students.
- --Fully empowered adult administrators.
- --Administrative policy and practice that is proactive rather than reactive in dealing with adult students, their needs, and their problems.

A TYPOLOGY OF STUDENTS

Carole Kaswon (1980) developed a typology which helps to show the different characteristics and needs of the adult as compared to the younger student. (See Table III.) The development of the typology was undertaken because she felt that higher education has not sufficiently acknowledged adult education in its mission, curriculum, or instruction. This composite typology of adult students as compared to younger students provides many basic, key differences that the personnel of colleges and universities should be aware of in order both to respond to the needs of and appreciate the differences between adults and younger students. However, it would seem important to acknowledge that some of the characteristics mentioned by Kaswon cross the boundaries she establishes for traditional and non-traditional students. Age does not always establish the boundaries of dependence and independence in terms of emotion, time focus, confidence, orientation, or decision making. This typology is best used as a general tool. There would seem to be areas of cross boundary competency and/or lack of competency in both younger and older students. The strong point of the typology is the potential for differences.

TABLE IV STUDENT TYPOLOGY (Kaswon, 1980)

YOUNGER STUDENTS	OLDER STUDENTS
1. Quasi-dependent beings	1. Independent beings
2. Limited emotional/financial support for significant others.	2. Major emotional/financial support for significant others.
3. Major time focus on academic and related extra-curricular activities.	3. Competing time focus on job, family, community, personal responsibility, in relation to academic activity.
4. High identification with student role.	4. Composite identification with many roles.
5. Seeking out self-identity.	5. Renewing self-identity.
6. Limited awareness of own capabilities.	6. Continuing growth of awareness of own capabilities.
7. Minimal exposure to life/career role models.	7. Significant exposure to life/career role models.
8. Minimal self-confidence and developing sense of maturity.	8. Developed and diversified self-confidence and maturity.
9. Introspective orientation.	9. Varied self/other orientation.
10. Impulsive (short-term) decision making.	10. Capacity for delayed gratification and long-term decision making.
11. Limited exposure to strategies for learning.	11. Varied strategies to learning.
12. Passive learner role.	12. Active learner role.
13. Limited history of self-directed learning.	13. Diversified opportunities for prior development of self-directed learning.
14. Minimal analytical critical problem-solving skills.	14. Developed analytical critical problem-solving skills.
15. Limited prior life experience.	15. Varied rich life opportunites and experiences.

SUMMARY

Ackell (1980) suggests that change is hardly ever easy, and growth is almost always incremental. People and organizations adapt to the present by building on a foundation of behaviors and structures developed in the past. Growth comes rapidly and easily in one area, slowly and with difficulty in other areas. But change does happen.

He suggests that there are several key developmental points in the evolution of a truly equitable model for re-entry education that can perhaps make the evolution a less painful process:

1. When a university has developed a substantial adult constituency, it should modify its mission statement to express clearly a commitment to adults and should assure that this change is fully understood and endorsed by the governing board.
2. The president and executive staff, especially the chief academic officers, must clearly, frequently, and consistently articulate the university's commitment regarding adult students to all university employees.
3. University long-range planning must consistently address the needs of adults as a major constituency of the university.
4. Offices of Student Life, Admissions, Registration, Financial Aid, Career Planning and Placement, and Counseling should be made aware that a substantial portion of the student body is over the age of 25 and aging and in need of their support.
5. The university should consistently work to develop a personal and institutional philosophy that embraces a commitment to serve and educate adults as equal members of the academic community.
6. Institutions should clearly and thoughtfully address the differences between traditional requirements for admissions, transfer, residency, and the real requirements necessitated by academic programs.
7. Appropriate classes, schedules and course continuations should be offered at times and places convenient to the total student body.
8. Universities need to recognize that adult students have schedules different from those of traditional students and thus require longer, later operation hours for many university functions and support services (bookstore hours, library hours, etc.). (Ackell, 1982)

The re-entry student is a consumer. The institution offers the product. There seems to be a need for an awareness of the problems each creates for the other. Universities need to be aware of the potential student market, adult students' needs, and the institution's responsibility to these adults as they become more and more numerous on the campus. Adult students need to be concerned with the impact they are having on the institutions and the traditional student body. Most importantly, adult students may have to realize that changes in traditional structures to accommodate adults and their time frames will take time and continued effort, and may not come as easily or readily as most adults would hope. Adult students as a group represent more diversity in life situations, goals, previous experiences, skill, intellectural capacities and styles of learning than most institutions are accustomed to acknowledging or planning for. A realistic awareness of this diversity is important for the institution and the student.

Perhaps what is most important is an awareness of what this can mean in terms of educational quality for the institution, the traditional student body and the non-traditional and re-entry student body. Educational institutions must learn to serve the students they do and could have, not continue in ways that served those they once had.

BIBLIOGRAPHY

Aasheim, L.J. "Re-Entry, The Student and the Institution", unpublished thesis, Pacific Lutheran University, Tacoma, Washington, May, 1984

Aasheim, L.J. Spring 1984 Re-entry Student Study, unpublished document, Pacific Lutheran University, Tacoma, Washington

Adler, Mortimer. "Why Only Adults Can be Educated" in Invitation to Lifelong Learning , Ed. Ronald Gross, Chicago: Follett Publishing Co., 1982

Ackell, Edmund F. "Adapting the University to Adult Students: a Developmental Perspective" OECC News Spring, 1982, p. 4-6

Apps, Jerold. "the Shape of Adult Education in the Eighties" in Invitation to Lifelong Learning, Ed. Ronald Gross, Chicago: Follett Publishing Co., 1982

Axford, Roger. Adult Education, The Open Door, Scranton, PA: International Textbook Co: 1980

Blaze, Wayne. College Degrees for Adults, Boston: Beacon Press, 1979

Boyer, Ernest; Levine, Arthur. A Quest for Common Learning, Carnegie Foundation for Advancement of Teaching: Washington D.C., 1981

Carnegie Council on Policy Studies in Higher Education. A Summary of Reports and Recommendations, San Francisco: Jossey-Bass Publishers: 1975

Cross, K. Patricia. Beyond the Open Door. San Francisco: Jossey-Bass, 1976

Cross, K. Patricia. Adults as Learners. San Francisco: Jossey-Bass, 1982

Cross, K. Patricia. "Missing Links in a Learning Society" in Invitation to Lifelong Learning. Ed. Ronald Gross, Chicago: Follett, 1982

Cross, K. Patricia. "Our Changing Students and Their Impact on Colleges: Prospects for a True Learning Society", Phi Delta Kappan, May, 1982, p. 627-630

Cross, K. Patricia; Valley, John. Planning Non-Traditional Programs San Francisco: Jossey-Bass Publishers: 1975

Feeney. Helen. "Women's Education" in Serving Personal and Community Needs through Adult Education. Ed. Boone, et. al., San Francisco; Jossey-Bass Publishers: 1981

Ferguson, Marilyn. The Aquarian Conspiracy. Los Angeles: CA, J.P. Tarcher, Inc. : 1980

Goldberg, Joan. "Counseling the Adult Learner," Adult Education, Vol. 39, No. 2, 1980, p. 67-81

Golladay, Mary. "The Condition of Education," National Center for Educational Statistics, U.S. Government Printing Office, Washington D.C., 1977

Gross, Ronald. Invitation to Lifelong Learning. Chicago, IL: Follett Publishing Co: 1982

Harnable, Couglous. "Research on Non-Traditional Students" *Colleges and Universities*, Summer, 1981, p. 330-331

Harrington, Fred. *The Future of Adult Education.* San Francisco, CA: Jossey-Bass Publishers: 1977

Hecht, Mariam; Traub, Lillian. *Dropping Back In*. New York: E.P. Dutton, 1982

Heppner, Mary; Olson, Sandra. "Expanding College Centers to Meet the Needs of Adults" *Journal of College Student Personnel*. March, 1982

Hodgkinson, Harold. "Guess Who's Coming to College". *Academe,* Vol. 69, No. 2, March-April, 1983

Hughes, Rees. "The Non-Traditional Student in Higher Education," *NASPA Journal*, Vol. 20, No. 3, Winter 1983

Kaswon, Carol. "The Older Student as an Undergraduate," *Adult Education*, Vol. 31 No. I, 1980, p. 30-47

Knowles, Malcolm. *The Modern Practice of Adult Education*, Chicago: Folett, 1980

Lenz, Elinor; Shevitz, Marjorie. *So You Want to Go Back to School: Facing the Realities of Re-Entry*. New York: McGraw Hill, 1977

Margarrell, Jack. "The Enrollment Boom among Older Americans," *The Chronicle of Higher Education*, May 4, 1981

Mardoyan, Jennifer; Alleman, Elizabeth, Cochran, John. "Adapting University Counseling Centers to Meet the Needs of an Older Student Body," *Journal of College Student Personnel*, March 1983, p. 138-143

Naisbett, John. *Megatrends*. New York, NY: Warner Books Inc., 1982

O'Connor, Kathleen. "Working With Non-Traditional Students: Women in Transition" *Teaching Newsletter* , the American Sociological Association, Vol. 8, No. 6, Dec., 1983

O'Connor-Blumhagen, Kathleen; Johnson, Walter, Eds. *Women's Studies; An Interdisciplinary Collection*. Westport, CT: Greenwood, 1978

O'Connor-Blumhagen, Kathleen. *Female Identity and Feminism*, St. Louis, Washington University doctoral dissertation, 1974

Rawlins, Melanie; Lenihan, Genie. "A Cooperative Endeavor for Integrating Re-Entry Adults in a 4-Year University," *Journal of College Student Personnel*, Nov. 1982, p. 531-537

Smith, Peter. "The Challenge of Diversely Prepared Learners," *College Board Review*. No. 125, Fall, 1982, p. 6-9

Surdam, Joyce; Glass, Marilyn. "A Working Model of Peer Advocacy for Re-Entry Students," *Journal of College Student Personnel*, January,1982

Tittle, Carol K.; Denker, Elenor R. Returning Women Students in Higher Education New York: Praeger, 1980

Watkins, David. "Institutional Research on Non-Traditional Students," Colleges and Universities, Summer 1981, p. 373-4

Wheaton, Janice; Robinson, Daniel. "Responding to the Needs of Re-Entry Women: A Comprehensive Campus Model," NAPSA Journal, Fall, 1983, p. 44-50

AN IN-HOUSE TRAINING PROGRAM TO CORRECT MATHEMATICS AND CHEMISTRY DEFICIENCIES AT LOS ALAMOS NATIONAL LABORATORY

by

Helena Whyte

Los Alamos National Laboratory

Abstract:

The Laboratory has been offering in-house training to improve basic mathematics skills since 1979. The eight module math continuum is structured so that it can successfully correct and identify basic skills and knowledge deficiencies of Los Alamos National Laboratory technician employees.

The Laboratory has also designed a training program in chemistry that has been offered since 1981. The target group of chemical technician employees has serious deficiencies in basic chemistry skills and knowledge resulting in poor motivation and problems in laboratory safety. The chemistry continuum is composed of nine modules that are based on a practical laboratory approach.

The development and interrelationships of these two programs will be discussed in terms of job performance analysis, task analysis, training design, and performance measures. The results, revisions, and comments from past participants will also be shared.

INTRODUCTION:

The Training Office (PA-15) at Los Alamos National Laboratory has designed and developed a training/education program for the Laboratory's technicians. This organization provides a program that will successfully, within one year, correct identified basc skills and knowledge deficiencies of the technician employees. Within three years the program can achieve a long-term goal of developing a para- profesional technician team member.

PROBLEM STATEMENT:

Technicians at the Laboratory need to correct and improve skills and knowledge deficiencies. There is a need to increase their safety awareness and to impact the image of themselves as para-professional technicians

The target group of technician employees represents a segment of the employee population for whom the problem statement need is especially acute. The target group has serious deficiencies in basic chemistry skills and knowledge. The implications for problems in laboratory safety because of these deficiencies and general lack of awareness are serious. The technicians are poorly motivated and not academically prepared for the work they must do. An identified need exists to motivate these employees to learn basic concepts in applied chemistry and related practical mathematics and to raise their awareness of safety considerations.

PROGRAM DESIGN:

In the early sixties, the American Chemical Society became concerned about the role of the technician. The heart of the problem seemed to be that technology instructors were forced to adopt university-level texts for students who did not need,were not interested in, and could not understand the abstract principles which formed the basis of the texts. There is little doubt that the first two years of a four-year university curriculum is not a satisfactory preparation for a chemical technician. The typical university course emphasizes the broad theoretical foundations of chemistry and the accompanying laboratories serve to augment the student's understanding. Courses for technicians should be based on a practical laboratory approach supplemented by enough theory to explain what the experiment shows.

Programs to train chemical technicians have been available in a number of two-year community colleges, junior colleges, and technical institutes. Most of these programs have included standard university-type courses in general, analytical, and organic chemistry taught in much the same manner and with the same texts as their university counterparts. Students who could survive this type of program were not content to become technicians and instead went on to finish a four-year program. The vast majority of students who did not survive did not become technicians either. This latter group of students, who had some interest in chemistry but could not survive a standard university curriculum, is the very group who should have become technicians. The end result has been frustration for students and instructors.

The PA-15 training program models its design on the Chemical Technician Curriculum Project (ChemTeC). This project began in 1969 with a National Science Foundation Grant to the American Chemical Society for development of instructional materials to be used in the chemistry core of technician training programs. The ChemTeC Project is aimed at training chemical technicians, primarily at two-year colleges, for subsequent employment in industry and R & D labs. Guidelines for the PA-15 program are:

1. Keep the language simple and conversational.
2. Do not use so many words that what should be easy becomes difficult.
3. Adopt a phenomenological approach. Do, observe, interpret, and then explain the concepts, rather than do experiments to illustrate abstract ideas.

4. Give reasons behind the facts where appropriate.
5. Justify why a topic is important to the student.
6. Use experiments related to common experience where possible.
7. Keep the mathematics to elementary algebra, logarithms, and graphs.
8. Repeat concepts with a gradual increasing of sophistication and a broadening of significance.
9. Think in terms of questions the student should be able to answer.

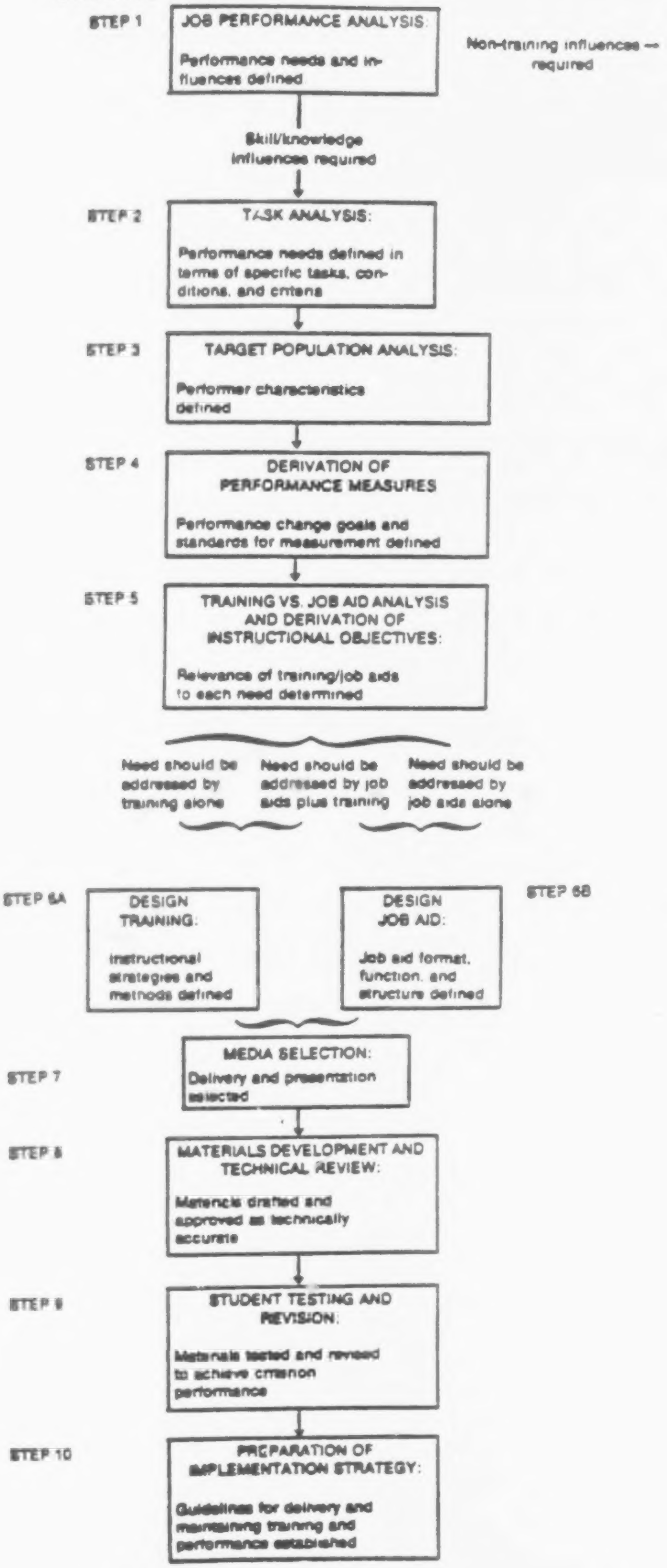
This program's imperative is to involve students in **doing**. The stress is on application rather than theory. Being technique-oriented, the technician should be able to take the burden of routine laboratory operations from the professional staff member, thereby allowing the latter more time to concentrate on the broader aspects of the job.

Detailed knowledge of mathematics, other than familiarity with algebra, isn't a prerequisite, nor is a previous knowledge of chemistry. Mathematics can be made palatable to weak students if it is taught in the proper context.

CURRICULUM DEVELOPMENT:

"Fundamentals of Chemistry" was first taught in 1980 at the request of one of the Laboratory managers. Other managers heard of the short course and asked to take part. Managers and technicians realized that Fundamentals of Chemistry was only a "bandaid" to the need for training. Thus the Chemistry Module Series has evolved over the years as seen in Table 1. Most technicians needing chemistry training work in radiochemical, explosive, analytical, geologic, or health related groups. I was once a supervisor in a radiochemical group and an analytical group so I was aware of the tasks involved in carrying on these various jobs. I began working with this program in August 1982. The strategy in Figure 1 was used to determine the module names and sequences.

Figure 1. Instructional Systems Development: Steps and Outcomes


STEP 1
JOB PERFORMANCE ANALYSIS:
Performance needs and influences defined
Non-training influences — required
Skill/knowledge influences required
STEP 2
TASK ANALYSIS:
Performance needs defined in terms of specific tasks, conditions, and criteria
STEP 3
TARGET POPULATION ANALYSIS:
Performer characteristics defined
STEP 4
DERIVATION OF PERFORMANCE MEASURES
Performance change goals and standards for measurement defined
STEP 5
TRAINING VS. JOB AID ANALYSIS AND DERIVATION OF INSTRUCTIONAL OBJECTIVES:
Relevance of training/job aids to each need determined
Need should be addressed by training alone
Need should be addressed by job aids plus training
Need should be addressed by job aids alone
STEP 6A
DESIGN TRAINING:
Instructional strategies and methods defined
STEP 6B
DESIGN JOB AID:
Job aid format, function, and structure defined
STEP 7
MEDIA SELECTION:
Delivery and presentation selected
STEP 8
MATERIALS DEVELOPMENT AND TECHNICAL REVIEW:
Materials drafted and approved as technically accurate
STEP 9
STUDENT TESTING AND REVISION:
Materials tested and revised to achieve criterion performance
STEP 10
PREPARATION OF IMPLEMENTATION STRATEGY:
Guidelines for delivery and maintaining training and performance established

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The following table shows the evolution of the chemistry continuum.

Table 1.

FY 80-82	FY 83	FY 84	FY85
Fundamentals of Chemistry	Applied Chemistry for Techs I & II	Applied Chemistry for Techs	Applied Chemistry for Techs
	Analytical Chemistry	Analytical Chemistry	Analytical Chemistry
	Chemical Instrumentation Technology	Introduction to Radiochemistry	Chemical Laboratory Procedures & Techniques
	Chemical Laboratory Procedures and Techniques	Technology of Materials	Chemistry of Hazardous Materials
	Introduction to Radiochemistry		Chromatographic Techniques
			Introduction to Radiochemistry
			Intermediate Radiochemistry

It is a well-established precept that successful performance in Chemistry courses requires appropriate mathematical knowledge and skill.

The Math Continuum is unlike an academic program in several ways:

- The Math Continuum is structured so that it can successfully correct and identify basic skills and knowledge deficiencies of Los Alamos National Laboratory technician employees.
- The instructors in the mathematics programs are particularly qualified to teach adult students with learning deficiencies. The program's success rates attest to the skill and competency of the instructors.
- The Mathematics Continuum allows students entrance to and exit from a number of programs, both degreed and nondegreed, Figure 2.
- Most importantly, the mathematics continuum builds and reinforces self-image in the students.

Students are given a pretest to determine where they enter the program. We have found that many of our technicians need to take one or two modules in the Math Continuum before progressing to our Chemistry series.

The Chemistry Continuum is presented in Figure 3. The Chemistry curriculum also allows students entrance to and exit from a number of programs. Students with no previous background in Chemistry begin either with Applied Chemistry in the series or a beginning level University course.

Continuing Education Mathematics Program Integrated with Chemistry and Physics

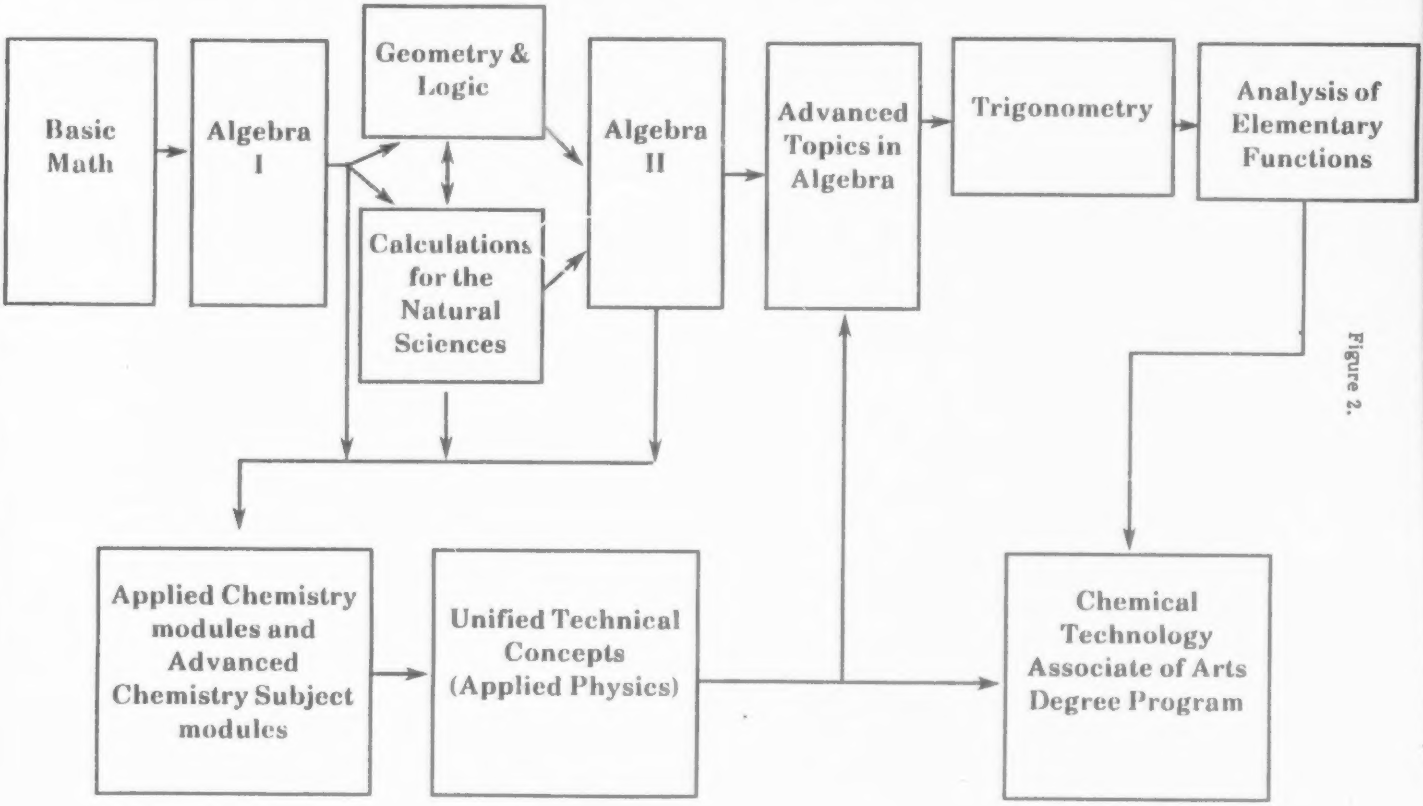
Basic Math
Algebra I
Geometry & Logic
Calculations for the Natural Sciences
Algebra II
Advanced Topics in Algebra
Trigonometry
Analysis of Elementary Functions
Applied Chemistry modules and Advanced Chemistry Subject modules
Unified Technical Concepts (Applied Physics)
Chemical Technology Associate of Arts Degree Program

Figure 2.

Systematic Training Program for Los Alamos National Laboratory Chemical Technicians

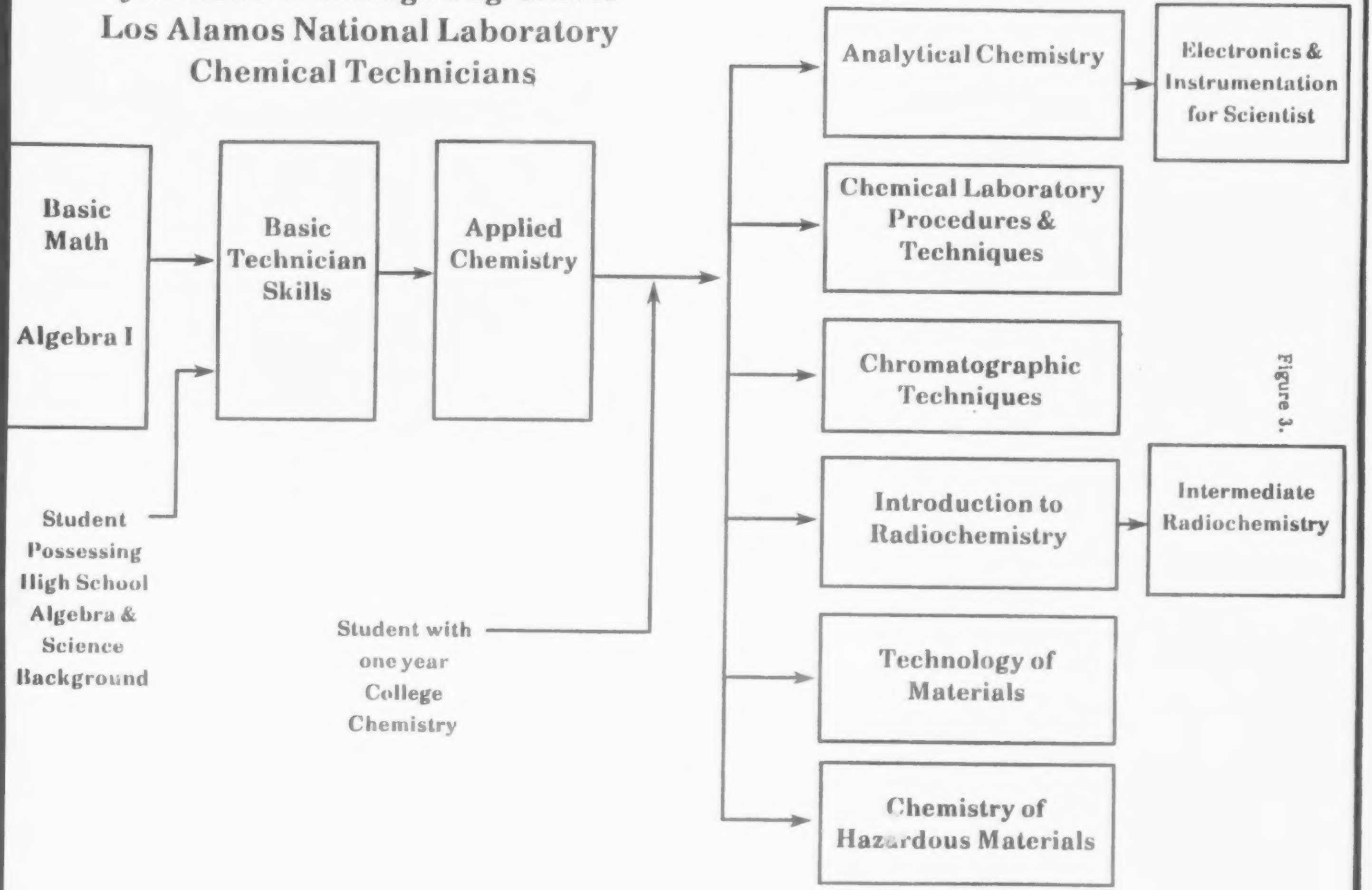
Basic Math
Algebra I
Student Possessing High School Algebra & Science Background
Basic Technician Skills
Applied Chemistry
Student with one year College Chemistry
Analytical Chemistry
Electronics & Instrumentation for Scientist
Chemical Laboratory Procedures & Techniques
Chromatographic Techniques
Introduction to Radiochemistry
Intermediate Radiochemistry
Technology of Materials
Chemistry of Hazardous Materials

Figure 3.

After introductory work is done, students take only those modules that directly relate to their job assignment.

The training program's objectives are:

- To train students in the safe and accurate use of common laboratory techniques.
- To acquaint students with the language of chemistry.
- To teach the basic chemical principles.
- To teach some descriptive chemistry as it is currently used.
- To skillfully accumulate and present data.
- To recognize inconsistencies in data; to distinguish good data from bad.
- To have some feeling for the basic statistical significance of experimental results; to make routine calculations.
- To sufficiently understand chemistry to appreciate the meaning of results (although actual data interpretation is the responsibility of the professional personnel).
- To select, understand, and carry out procedures accurately and safely.
- To converse in the language of chemistry and to report one's work in a proper fashion.

These measurable program outcomes help to alleviate the problem of the target group's assessed need and assist in the development of professional technicians at the Laboratory.

COURSE DELIVERY:

The PA-15 mathematics programs run for ten week intervals. Students meet with the instructor twice a week for an hour and a half. Classes meet during working hours so that class attendance becomes part of the job assignment. Each math module consists of 30 contact hours. A pre-test is given during the first class period. A post- test is given at the conclusion of the course with a certificate of completion being issued to those demonstrating a 70% or higher proficiency level on the test. We have trained 470 students since 1979. Ninety-seven percent of the participants successfully complete the course the first time through. Those who are unsuccessful, usually have a poor attendance history or were marginally allowed access to that level of study. Mathematics texts are listed in Table 2. Texts are chosen for readability, clarity of examples, and immediate availability of answers.

The PA-15 Chemistry programs run for five days concurrently from 8:30 a.m. - 4:30 p.m. Each Chemistry module is an intense learning experience. A pre-test is given during the opening hours of the course. A post-test is given at the conclusion of the course with a certificate of completion. We have trained 170 students since 1980. Students generally increased their scores by 41% during this one week interval. Students who have completed more than one module on the continuum generally score higher on both the pre-test and the post-test. The instructors in the Chemistry program are particularly qualified to teach adult learners with learning deficiencies. These instructors also have extensive experience training technicians and have had industrial, as well as, teaching experience. The Chemistry texts are listed in Table 3. Chemistry texts are chosen for readability, content, and possible use as a later reference.

Table 2. Mathematics Texts Used:

Basic Math	Basic Mathematical Skills: A Guided Approach; Carmen and Carmen, John Wiley & Sons, Inc., 1981.
Algebra I	Introductory Algebra; Keedy & Bittinger, Addison-Wesley Publishing Co., 1983.
Intermediate Algebra	Intermediate Algebra: A Guided Approach; Carmen and Carmen, John Wiley & Sons, Inc., 1980.
Advanced Topics in Algebra	Intermediate Algebra: A Guided Approach; Carmen and Carmen, John Wiley & Sons, Inc., 1980.
Geometry and Logic	Introductory Geometry; M.K. Hudspeth, Addison-Wesley Publishing Co., 1983.
Calculations for the Natural Sciences	Schaum's Outline Series: Physical Science; A Beiser, McGraw-Hill, 1974.
Trigonometry	Plane Trigonometry: A New Approach; C.L. Johnston, Prentice-Hall, Inc., 1978.

Table 3. Chemistry Texts Used:

Applied Chemistry	Basic Chemistry; Seese & Daub, Prentice-Hall, Inc., 1981
Analytical Chemistry	An Introduction to Chemical Analysis; Harris & Kratochvil, Saunders College Publishing, 1981.
Chemical Laboratory Procedures & Techniques	Chemical Technicians' Ready Reference Handbook; Shugar, Bauman and Bauman, McGraw-Hill, 1981.
Introduction to Radiochemistry	Principles of Radioisotope Methodology; Chase & Rabinowitz, Burgess Publishing Co., 1967.
Intermediate Radiochemistry	Principles of Radioisotope Methodology, Chase & Rabinowitz, Burgess Publishing Co., 1967.
Technology of Materials	Materials Science and Metallurgy; Pollack, Reston Publishing Co., Inc., 1981.
Chemistry of Hazardous Materials	Chemistry of Hazardous Materials; Meyer, Prentice-Hall.
Electronics & Instrumentation for Scientists	Electronics and Instrumentation for Scientists; Malmstadt, Enke and Crouch; Benjamin Cummings Publisher.

EVALUATION:

As indicated earlier, student performance is measured using pre- and post-tests. The 97% proficiency rate for the mathematics students and the average 41 point gain for the Chemistry students shows the success of our programs. An historical look at the pre- and post-test Chemistry data is shown in Table 4.

Table 4:

Course Title	Year	Pre-Test Average	Post-Test Average
Applied Chemistry for Technicians	1983	30	81
	1984	47	86
Analytical Chemistry	1982	29	77
	1983	32	66
	1984	45	90
Chemical Laboratory Procedures and Techniques	1983	32	58
Introduction to Radiochemistry	1983	30	85
	1984	54	94
Technology of Materials	1984	44	66

However, PA-15 is not not satisfied with just these results. PA-15 also has the students fill out an evaluation for the course. The responses help PA-15 to update and revise courses. These responses also help PA-15 to determine what other training needs the technicians have.

The questions asked on the evaluation form are:

1. How will you apply the material from this course to your job?
2. What did you most enjoy about the course?
3. What did you least enjoy about the course?
4. What suggestions do you have for improvement of this course?
5. Are there any other courses you would like to see offered?

Here are some student responses:

> "It has improved my self-image to know that I can still learn and feel more intelligent with my co-workers who have a higher education than I do."
>
> "I work in computers and find the need for math and the lack of math anxiety useful. I expect to continue in the math series to further my math skills and aid in my further progress with computer science."
>
> "I write computer graphics user documentation, and learning the geometry/logic concepts will enable me to describe graphic concepts much better for users."
>
> "I will use the material in applying some of the basic equations and formulae to practical problems encountered on the job."
>
> "I can better understand a staff member when he is explaining things in chemical terminology."
>
> "I am more confident; I am a more valuable employee because of my increased chemical knowledge."
>
> "Most all the material in this course I will apply and have applied at my job. I have been able to be more independent in working out problems. I have learned chemistry terms and can understand them."
>
> "I have a better understanding of the processes at work. Now I know why and how things are done. I get personal satisfaction and I feel more confident at work, and that's a good feeling."

"I can apply it to my job because I'm involved with a lot of titration and I have a greater knowledge of how to use the various calculations."

"I learned more about counting systems and a better understanding of formulae I use very frequently; on the whole this course has filled in some gaps and given me a better sense of confidence."

I learned many sampling techniques and ways to solve problems...also how to piece together different parts of a puzzle to find the complete picture."

"It will come in handy to know which solvents will dissolve which."

"The coursework on phase diagrams was directly related to my work. The study of steel gave me an overall intuitive comprehension of the behavior of metals."

PA-15 would still like to do more in terms of cost effective analysis. The best way to determine the skill proficiency is to visit the technician on the job before and after the class, but this is costly and time consuming. I am currently developing an evaluative instrument in the affective domain to determine if job performance has improved. An example of such an instrument is shown in Figure 4. James Popham and Elanna Yallow of IOX Assessment Associates in California have shown that such an instrument can be valuable and time effective.

CONCLUSION:

The success of the Laboratory's Training program is best expressed by this student comment: "The course not only increased my job awareness but enabled me to communicate to supervisors and staff members in technical terms thus making for a better working environment." This indicates achievement of the long-term goal of developing a paraprofessional from an employee who lacked chemical and safety knowledge and was poorly motivated.

BIBLIOGRAPHY:

"Career Opportunities for Chemical Professionals"; Chemistry and Engineering News, Vol. 62, Oct. 22, 1982. Pages 29-38.

"Chemistry Core Outlined for Technicians"; Chemistry and Engineering News, Vol. 45, May 22, 1967. Pages 46-51.

"Cost Effectiveness of Training Course" by W.J. Popham and E.S. Yallow, December, 1982.

G.L. Cordova, Los Alamos National Laboratory, unpublished data, 1982.

Modern Chemical Technology, ChemTeC Project Writing Team, American Chemical Society, Washington, D.C. 1979. 8 vols.

Figure 4.

The survey describes some expected outcomes of the 9-month **Chemistry for Technicians** course (August 1984 - May 1984). Circle **YES** or **NO** to show whether this statement applies to your situation.

If you circle **YES**, then use the confidence scale to show how certain you are of this ability/feeling.

The following examples show how the confidence scale is used.

Skill Examples	CAN YOU DO THIS?	IF YES HOW CERTAIN ARE YOU?
You can balance equations.	[✓ YES]/NO	90
You can write a quarterly report.	YES/NO	___

Confidence Scale

10 20 30 40 50 60 70 80 90 100
Very Uncertain
Somewhat Certain
Very Certain

TECHNICIAN SURVEY

	TASKS FOR TECHNICIANS OF TRAINING PROGRAMS	EXPECTED OUTCOMES	IF YES, HOW CERTAIN ARE YOU?
1.	I understand my job better because I had **Chemistry for Technicians.**	YES/NO	___
2.	I better understand the directions my supervisor gives me because I took **Chemistry for Technicians.**	YES/NO	___
3.	I can learn a new procedure on the job faster because I took **Chemistry for Technicians.**	YES/NO	___
4.	I can better communicate with my supervisor (i.e., job performance, work problems, etc.) because I took **Chemistry for Technicians.**	YES/NO	___
5.	I feel better about myself as a person because I took **Chemistry for Technicians.**	YES/NO	___
	What final grade did you receive?	___	
6.	I use the lecture material on my job.	YES/NO	___
7.	I use the laboratory techniques learned on my job.	YES/NO	___
8.	I use the report writing skills learned on my job.	YES/NO	___
9.	My expectations concerning the outcome of the course were met.	YES/NO	___
	Please give reasons if answer is no.		
10.	I am taking U.N.M. course work this semester.	YES/NO	___
11.	I plan to pursue an associate degree at U.N.M.	YES/NO	___
12.	I have taken additional training at PA-15.	YES/NO	___
13.	I plan to take further training at PA-15.	YES/NO	___

14. Any comments you would like to make? (Particularly comment on how your work life changed as a result of completing **Chemistry for Technicians.**)

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QUEST FOR QUALITY

by

Donald C. Roush

Executive Vice President

New Mexico State University

It is a great pleasure to dedicate this "Last Lecture" to Dr. Verna L. Vickery, Professor of Education and Specialist in Reading at NMSU from 1962 to 1970. Dr. Vickery, an inspiring teacher, had considerable impact upon those she taught, and through her expertise and dedicated service, had a marked effect upon the improvement of reading program in the public schools of New Mexico.

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This may be the last opportunity I will have to visit with you about teaching. As you know, I plan to terminate from the university on June 30, and pursue another career. Notice, I am not going to retire; I learned three or four years ago not to talk about my retirement at the university--and with good reason. In leaving Hadley Hall one day, I met Dr. Newman Reed, emeritus head of the English department. Newman is known for his dry wit. I said, "Hi, Newman, how are you?" "Just fine." I said, "Are you enjoying retirement?" "Don, it's the best decision I ever made." I said, "I sure am looking forward to the day when I retire," and without hesitation Newman replied, "Yes, Don, and there are a lot of others around here looking forward to that day, too."

It has been my great privilege as the chief academic officer of the university to work with three presidents. Many of you know that I remained this extra year to provide continuity of the operation and give President Halligan the opportunity to choose the next executive vice president. It is a pleasure to work with Dr. Halligan; I predict he will be another great president. Also, I would like to say how very, very proud I am of the faculty we have been able to attract and retain at the university. The productivity of the faculty speaks for itself as we look back on the progress we have made.

The paper I will present today has two parts--the first includes a discussion of faculty researchers and teachers--some ironies, arrangements, and a major recommendation; in the second part, I present what I believe are the three most essential components of effective teaching.

As I talk about teaching today, understand that I am cognizant of the importance of research. There is no need to decide whether one is more important than the other. We know that scholarly work enhances teaching, and

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vice versa. But a major unresolved problem is the short shrift teaching receives in the reward system compared to research. This problem is the inevitable result of the differences in opportunities. For example, as faculty members write up their research and compete in the marketplace for the results to be published in a refereed journal, they are able to submit very factual evidence of accomplishments. As more and more articles are published, researchers often receive national and international recognition for their work. Research opens doors of opportunity for additional extrinsic recognition and rewards through the funding of grants and contracts which generate needed overhead funds for the university, the college, and the department.

These opportunities are pursued at NMSU with considerable success--as they should be. The problem is that none of the above applies to teaching.

Fortunately, the faculty researcher is also concerned about being an effective teacher, but the teaching evidence he/she submits cannot equal the evidence of research accomplishments. Although the faculty researcher may be a star in the classroom, it is unlikely his/her teaching reputation will exceed the boundaries of the campus. Consequently, an average or even below-average teacher, but a productive researcher and writer, has an easier time with the award of tenure, promotions, and salary increases. These disproportionate salary increases for the researcher, ironically, come from funds generated through the production of student credit hours--in other words, the teaching of students. Teaching supports research rewards, and inevitably, the successful researcher spends less and less time in the classroom. Good teaching comes out on the short end--twice--in spite of the fact that President Halligan and many others have declared that teaching students at the university is our most important priority and the very reason for our existence.

Given all of this, it would seem logical to establish some different arrangements for teaching. These arrangements would include great care in the evaluation and reward of teaching. The rewards for teaching would be equal to or exceed those of research, because the only extrinsic recognition great teachers receive in the reward system is that given to them by the university itself. If teaching and research are to be equally rewarded, we would give more of our attention to the exploration of ways to build a higher confidence level in the evaluation of teaching, followed by clearly understood and effective rewards. We have been attempting to do precisely those things for a number of years on this campus and, in my experiences visiting other universities, we are far ahead in our efforts. Currently, recommendations on evaluating and rewarding teaching, prepared by the President's Committee on College Teaching and the deans' council, are being discussed in the departments which hopefully will lead to the adoption of recommendations contained in this paper.

It is true, as some faculty members have exhorted, that the instruments to measure teaching are imperfect. But it is also true that the instruments we use to measure student learning are imperfect. Thus it is incongruous, if not hypocritical, to assume a posture that teaching escapes evaluation because the measuring instruments are imperfect. We are not constrained in our attempts to evaluate students. The same should apply to the evaluation of teaching.

Surely, an institution dedicated to searching for the truth can develop programs for effective teaching and its evaluation. But, for many reasons, seeking the truth does not seem to apply to teaching. Very few faculty members on our campus, or on any other campus for that matter, engage in pursuing the unknowns about teaching effectiveness, evaluation, and reward. For example, in my searches of the literature on research about college teaching in 1976, 1979, and 1983, I found only 15 articles worthy of inclusion in my seminar paper on testing and grading. At the same time, I am certain that hundreds of attempts have been made by faculty to improve instruments in the measurement of student learning and to grade students in a fair manner. Unfortunately that information remains largely unpublished, because few faculty members on any university campus would dare devote their research interests to the improvement and evaluation of teaching, as opposed to research in a specific discipline. Formidable limits are placed upon those who would seek the truth about teaching and learning, and these obstacles suggest yet another irony, i.e., the benign neglect of research in teaching is the very reason we have so little confidence in the measurement of its effectiveness.

The need for research in teaching is next to unbelievable, as can be demonstrated by the following quote from Milton and Edgerly:[1]

> There are slightly more than a half million faculty members in American colleges and universities. If each teaches an average of two courses and prepares three tests for each course, at least 3 million exams are given during any quarter or semester. Since these examinations are administered to about 10 million students, about 30 million tests are given every 3 or 4 months, or over 100 million every academic year. This is measurement on a grand scale indeed.
>
> Considering that major decisions are made about students' lives, whether they remain in school, enter professional or graduate institutions, secure jobs, partially on the basis of those hallowed test statistics--the grade-point average--elaborate care

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[1] Ohmer Milton and John W. Edgerly, "The Testing and Grading of Students," Change, Change Magazine and Educational Change, 1976.

should be required in the entire testing and grading enterprise.

One could reasonably expect that elaborate care would include provisions for research. More academic sins, mostly unintentional, are created in testing and grading than in any other phase of teaching. Somehow, better arrangements must be found to encourage research about effective teaching, and bring to a close the long-standing, unintentional discrimination against teaching. I recommend the immediate formulation and implementation of an "R and R Program"--Recognition and Reward for those who excel as teachers and as researchers in teaching. An enlightened university such as this one has the opportunity to rescue teaching from the intellectual, moral, and social darkness which has surrounded it for so many years. Make no mistake about it, without this kind of justice, teaching will not receive its just reward.

If former Governor Bruce King were present at this point in my talk, he would more than likely say, "Dean Roush, you sure have opened a box of pandoras."

Any serious quest for quality in teaching, such as the proposed R&R Program, must include at least five arrangements:

1. Provisions for faculty to become more effective teachers,
2. Provisions for research about teaching and learning,
3. Incentives to excel in teaching,
4. Generous rewards for effective teachers, and
5. Demonstrable actions which convey that good teaching is highly valued.

Sometimes these five arrangements seem out-of-reach. But do not despair. Successful faculty, both teachers and researchers, are driven by a powerful force, one which makes all teaching worthwhile--that is to witness learning in others, the satisfaction of seeing our students become wiser, more knowledgeable, and more sure of themselves.

One of the most thrilling experiences in life is to teach others. Teaching is a marvelous and exciting profession, but the intrinsic opportunities to experience this excitement, to nurture the minds and lives of students cannot continue to serve as the only reward.

Words taken from the Report of the National Commission on Excellence in Education, A Nation at Risk,[2] help express a perfect conclusion to the first part of this paper--The twin goals of teaching and research have profound meaning to the university, and we cannot permit one to yield to the other in principle or in practice.

In part II, I wish to share with you the three most critical components of teaching which absolutely make a major difference in the teacher's successful quest for quality.

These conclusions are drawn from studies of the literature on college teaching and from hundreds of faculty participants in my seminars.

Organizing for teaching is the first component. The planning faculty members do before the first class meeting has a marked effect on the success of the teacher and the learner. This conclusion is based upon the following principles and assumptions:

1. Every teaching decision is driven by the stated purposes of the course. Thus, the goals of a given course are selected with great care and tested for appropriateness through the use of a matrix where every part of a course meets one or more of the stated goals. The exercise ensures consistency, avoids classroom management problems, and makes learning easier.

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[2] Jack R. Sharpe, Jr., "Book Reviews," National Forum: Phi Kappa Phi Journal, Winter 1984.

2. The average attention span of college students does not exceed 20 minutes. Moreover, Hartley and Davies in 1978 found in their studies of student attention during lectures that, "typically, attention increases from the beginning of the lecture to 10 minutes and decreases after that point. Evidence collected shows that after the lecture, students recalled 70 percent of the material covered in the first 10 minutes and only 20 percent of the material covered in the last 10 minutes."[3] Lectures which continue without interruption beyond 15 or 20 minutes are an inefficient use of student and faculty time. Thus, if we are to take full advantage of the opportunity during a 50-minute class to see that students learn as much as they possibly can, good planning is required. The organizational implications are enormous.

3. Students learn more when they are exposed to a number of teaching methods. The lecture is the least efficient teaching and learning mode. Lecturing is an effective way to present information, but an optimal combination of teaching methods is required to meet all student learning styles. Alternate ways for students to learn are selected from 26 teaching and learning modes. The inclusion of these alternatives requires astute planning.

4. High scholarly standards are clearly stated in both the rigor and currency of course content and the level of expected student performance with respect to those standards. The currency of a faculty member's information about a given course is and should be the primary responsibility of the faculty member, but at the same time departmental discussions are needed to update course syllabi, to keep up with the changes in the discipline, and to avoid duplication of information. Otherwise, organizing and planning take place in a vacuum.

5. In every course, the major ideas or concepts are clearly identified with specific facts taught in relationship to those concepts. Unstructured instruction is rapidly forgotten. This important faculty effort should also include discussions with peers in the discipline.

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[3] J. Hartley and I. K. Davies, "Note-Taking: A Critical Review," *Programmed Learning and Educational Technology*. 1978, Volume 15.

6 The nature of the discipline, anticipated maturity level of the students to be taught, and finally, the adoption of teaching strategies which fit the skills of the instructor are crucial considerations. In most classes of 25 to 30, 5 to 7 students, or perhaps more, will be "lost" from time to time as the course proceeds. Planning should anticipate this fact and include alternative ways for students to catch up without unduly occupying the time of the professor. In many of the disciplines, this accommodation can be accomplished through technology, such as cassettes, floppy disks, and so forth. "Floppies" are now available for several introductory courses and, when students fall behind, they can easily be referred to this source of information.

7. Technology, properly applied, results in greater teaching efficiency. Technologies available are largely unused, but that will change as the demand for accountability in instructional programs increases, as it surely will, and we struggle with the problems of increasing amounts of knowledge to be taught and learned. Attempts to solve these problems through the use of the same traditional approaches to teaching, but with a fifth year added are not realistic in view of the extra time and costs which would be demanded of the student, nor do I think it is necessary. Through imaginative and creative use of technology, five years of information can be taught in four. But the impact on course planning is extensive.

8. The testing and grading of students greatly influence student performance. When the first test hits the student's desk, the "moment of truth" has arrived. Students take their cues from the manner in which they are evaluated and graded. When students are tested for facts, they learn to memorize; when students are tested for understanding, they learn to think. A test that is fair, impartial, reasonable, and consistent with everything the teacher has said gives students every opportunity to succeed.

I trust these eight assumptions demonstrate the critical importance of organizing for teaching. A faculty member told me after a teaching seminar that he realized the planning he did was more for himself than for the students. Clearly, students are the beneficiaries of effective course organization and planning.

The second critical teaching component is the motivation of learners. Motivation is the principal task of the instructor because of the high correlation between the amount of motivation and the amount of learning. Motivation is the cornerstone of any serious quest for quality in teaching.

Motivating learners is simultaneously challenging, complicated, traumatic, climactic, exciting, and wonderful--all of which is confirmed by the following assumptions:

1. Learning is of itself a great motivator. A faculty member from the Department of Mathematics in one of my seminars said, "Don, I have no problem with motivation. Mathematics is beautiful." When we help students reach that gestalt, commonly referred to as the "Aha, I understand," they are unusually motivated.

2. Learner participation, response, and experience contribute significantly to motivation.

3. Experiences related to the subject are crucial to motivation and learning. For example, Mark Twain said, "I never let my schooling interfere with my education." He recognized the critical need for the integration of student experiences with education and the extensive implications to motivation.

4. To motivate, teaching strategies are designed to enhance learner security, acceptance, self-esteem, and self-actualization; that is, the satisfaction of knowing something or achieving one's potential.

5. Raising the sights of students motivates them. My freshman students always asked the periennial question, "Dr. Roush, how long does this term paper have to be?" I always answered with another question, "How good do you want to be?" The effective motivator of students makes "have to" become "want to." Many of my freshman students, unfortunately not all of them, discovered that academic excellence was clearly within their reach.

6. Perhaps the most important factor in motivation is assumption 6--that learners can receive major motivations from the classroom climate or atmosphere. The climate in which learners find themselves can be a major deterrent or a major contributor to motivation. Classrooms which motivate are "user friendly."

7. Teachers also receive major motivations from the institutional climate or atmosphere. Motivated teachers motivate students. Motivated students drive us to do our best. The conditions where teaching takes place should be ideal, not just adequate.

8. And, finally, assumption 8--Teachers in their quest for quality know there is something special in everyone. Helping students discover and enhance that specialty is a most powerful motivator.

The third critical component is the selection and employment of teaching strategies. Effective teachers are clever strategists. These strategies include, but are not limited to, teaching and learning modes, student response and experiences, student confidence, and values related to the discipline.

Discussion in teaching is much more than the elicitation of questions and anwers. The teacher is interested in the quality of student response and employs strategies to evoke meaningful responses which serve as the vehicle for clarification of the lecture and the teaching of additional information related to the topic. Teaching from what students say is a most effective tool.

A teacher's quest for quality uses an array of some 26 teaching and learning modes to involve students in their own education--helping them apply ideas and facts in their lives and gain insights into current problems. The central purposes of these strategies are the comprehension and retention of information, helping students develop confidence in their ability to learn, and providing continuous student motivation.

But the most effective and least used teaching strategy is the inculcation of values related to the discipline in the teaching and learning plan. Why is student discussion of these values so powerful?

a. Perceptions are constantly infiltrated with values.

b. Values serve as the authorities in the name of which choices are made and actions are taken.[4]

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[4] Richard C. Morrell, Teaching Values in College, Jossey-Bass Publishers, 1980.

c. What students do and believe depends upon their attitudes, philosophies, and value judgements.

Faculty in my teaching seminars always devote considerable time and discussion to these statements on values. I promise you the same will happen in your classrooms. And your students will 1) gain a deeper understanding of the subject, 2) display a greater interest in the subject, and 3) retain more information about the subject.

In summary, it is through these critical components--organizing, motivating, and postulating teaching strategies that our classrooms are more apt to serve as places where the zeal of the student to learn and the zeal for scholarship of the professor meet head-on. Teaching is a process of planning, organizing, motivating, evaluating, and strategically employing selected strategies. The effective teacher possesses an unquestioned command of the subject, passion and compassion--a passion for teaching and a compassion for those they teach. Teaching is the conscience of a university.

I will close this talk with another story about Mark Twain. When he had finished his book, Life on the Mississippi, he showed considerable diffidence and caution in its preface, apparently due to some abuse at the hands of his previous "scholarly" critics, by stating, "Persons attempting to find a motive in this narrative will be prosecuted. Persons attempting to find a moral in it will be banished; persons attempting to find a plot in it will be shot."[5]

Without any diffidence or caution whatever, I say to you that persons attempting to find a motive in my narrative, surely will. Persons attempting to find a moral in it will be saints. Persons attempting to find a plot in it will not.

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[5] Dave Brinegar, "The Man From Hannibal," The American Way, June 1973.

Most of you know that I am an eternal optimist--it is a requirement of the position. But, who knows, perhaps some of my dreams about teaching will come to pass. Warren Bennis said that "changing a university is more difficult than reorganizing a cemetery." But Mr. Bennis does not know that change is something we do very well at New Mexico State University.

BIOGRAPHY - DONALD C. ROUSH

In celebration of his 35 years dedicated to the improvement of teaching in New Mexico, New Mexico State University's Executive Vice President, Donald C. Roush, made a special address, "The Quest for Quality," at the Conference. Dr. Roush, who has announced plans to retire in July of 1985, has been involved in New Mexico education since 1950, when he began teaching in Los Alamos. There he was an elementary, junior and senior high school teacher as well as a high school principal. In 1955, he became director of field services for the New Mexico Education Association (now National Education Association - New Mexico).

Four years later, Dr. Roush joined the faculty of New Mexico State University and became Dean of the College of Education. He retained this position until the summer of 1968 when he was appointed Academic Vice President, with the title changing to Executive Vice President in 1979.

Dr. Roush is past president of the North Central Association and an examiner and consultant for North Central. He has published extensively in the field of education and is called on frequently as a consultant at both national and state levels. Over the last 21 years, his seminars on university teaching effectiveness have gained international recognition.

Dr. Roush received a bachelor's degree from Drake University and his doctorate from the University of Northern Colorado. In 1982, he was honored by the University of Northern Colorado as Outstanding Alumnus in the Field of Education.

New Mexico State University honored Dr. Roush in January 1983 with the President's Award for Service in recognition of a career dedicated to excellence in teaching as manifested by his outstanding work with faculty and students at New Mexico State University and other universities.

APPENDIX

DONALD C. ROUSH AWARDS FOR TEACHING EXCELLENCE - 1985

COLLEGE OF AGRICULTURE & HOME ECONOMICS

Lowell B. Catlett, Associate Professor, Agricultural Economics
and Agricultural Business
Ph.D. - 1980, Iowa State University

COLLEGE OF ARTS & SCIENCES

Bradley A. Blake, Professor, Sociology and Anthropology
Ph.D. - 1970, University of Wisconsin, Madison

Vicente D. Villa, Professor, Biology
Sc.D. - 1969, Rice University

COLLEGE OF BUSINESS ADMINISTRATION & ECONOMICS

James Mensching, Associate Professor, Accounting & Finance
Ph.D. - 1976, University of Chicago, CPA

COLLEGE OF EDUCATION

Robert L. Gallegos, Associate Professor, Educational Specialties
Ph.D. - 1974, University of New Mexico

COLLEGE OF ENGINEERING

Satish J. Kamat, Professor, Industrial Engineering
Ph.D. - 1970, Texas Tech University

COLLEGE OF HUMAN & COMMUNITY SERVICES

John B. Savage, Academic Department Head, Professor, Health Science
Ph.D. - 1975, University of Utah

Jimmy E. Smith, Professor, Mathematics, NMSU-Alamogordo
Ph.D. - 1973, University of Texas, Austin

Judith A. Moore, Professor, English, NMSU-Carlsbad
M.A. - 1964, Western New Mexico University

Marvin G. Rider, Instructor, Secretarial Administration
and Accounting, NMSU-Grants
M.A. - 1972, University of New Mexico

Barbara Raub, Assistant Professor, Secretarial Administration
NMSU - Dona Ana
M.S. - 1977, Eastern New Mexico University

Note: Recipients of the Donald C. Roush Awards for Teaching Excellence were chosen by the Deans of the six colleges at New Mexico State University based on input from a variety of sources including the results of the 1984 Commencement Survey.

Wednesday, January 9, 1985 & Thursday, January 10, 1985

10:30 a.m. - 1:30 p.m.

3:30 p.m. - 4:30 p.m.

COMMERCIAL DISPLAYS

DIGITAL EQUIPMENT CORPORATION (DEC)

HEWLETT-PACKARD CORPORATION

INTERNATIONAL BUSINESS MACHINES (IBM)

NATIONAL CASH REGISTER (NCR)

TANDY (RADIO SHACK) CORPORATION

HOLGUIN & ASSOCIATES CORPORATION

NEW MEXICO STATE UNIVERSITY FACULTY DISPLAYS

Center for Educational Development

Dr. Darwin Hunt - Experimental Training Center

Dr. Colleen Jackson - Department of Speech

Dr. Larry Reitmeyer - Department of Astronomy

COMMITTEE ON COLLEGE TEACHING

Lowell Catlett	College of Agriculture & Home Economics
Tom Cyrs	Center for Educational Development
Marie Heaton	College of Arts & Sciences
Jo Hill	College of Human & Community Services
William Kersting	College of Engineering
Margie Kitano	College of Education
John Loveland Chairman, 1984	College of Business Administration & Economics
Joseph Rogers Chairman, 1985	College of Arts & Sciences
M. E. Wolf	Office of the Vice President

CONFERENCE COORDINATORS

Carlton Dukes	Vendor Track Coordinator
Miriam Meyer	Program Coordinator

ALPHABETIC LISTING OF AUTHORS

Aasheim, L. J. (Kemmie)	Pacific Lutheran University
Baker, Greg	New Mexico State University
Balzer, Eugene W.	Northern Arizona University
Balyeat, John R.	United States Air Force Academy
Blake, Martin J.	New Mexico State University
Borrebach, David E.	LaRoche College
Burr, A. F.	New Mexico State University
Burr, Marjorie	New Mexico State University
Cartwright, G. Phillip	Pennsylvania State University
Chang, Moon K.	Peru State College
Conover, W. J.	Texas Tech University
Corder, Jim W.	Texas Christian University
Cowan, George	Los Alamos National Laboratory
Craver, Lionel	University of Texas at El Paso
Creel, Bob	New Mexico State University
Davis, Larry P.	United States Air Force Academy
Dingman, Paul R.	Oregon Graduate School of Professional Psychology
Donart, Gary	New Mexico State University
Duckworth, Victoria C.	University of Houston, Downtown College
Farrell, Mark O.	LaRoche College
Giordano, Gerard	New Mexico State University
Harris, Betty	New Mexico State University
Hoban, Michael T.	LaGuardia Community College, CUNY
Holmes, David R.	University of Vermont
Hunt, Darwin	New Mexico State University
Jones, Jesse L.	United States Air Force Academy
Jones, Lawrence G.	United States Air Force Academy
Jung, Phillip	United States Air Force Academy
Kirk, Edward L.	Abilene Christian University
Krause, Kenneth L.	United States Air Force Academy
Lier, Ruth	Los Alamos National Laboratory
Long, Richard L., Jr.	New Mexico State University
Lucking, Robert	Old Dominion University
Lujan, C. Lance	New Mexico State University
Marshall, James P.	University of Northern Colorado
May, William F.	Georgetown University
Merrill, M. David	University of Southern California
Moulton, Gary M.	Mind Nautilus Industries
Noetzel, Jonathan C.	United States Air Force Academy
Nordyke, James	New Mexico State University
O'Connor, Kathleen	Pacific Lutheran University
Potter, Eugenie	Arizona Research Associates
Randolph, Paul H.	Texas Tech University
Richards, Boyd	Hazeltine Corporation
Richardson, William E.	United States Air Force Academy
Ross, Eugene	New Mexico State University
Roueche, Suanne D.	University of Texas at Austin

ALPHABETIC LISTING OF AUTHORS

Roush, Donald C.	New Mexico State University
Schreier, James W.	Marquette University
Schroder, Darrel	University of Texas at El Paso
Scott, Stanley S.	Peat, Marwick, Mitchell & Co.
Smith, Sara Dawn	University of New Mexico
Sproull, Frederick	LaRoche College
Storch, Donn M.	United States Air Force Academy
Strawser, Larry D.	United States Air Force Academy
Tarquin, Anthony	University of Texas at El Paso
Urquhart, N. Scott	New Mexico State University
Wade, James	University of Arizona
Walker, Kim B.	University of Colorado
Whyte, Helena	Los Alamos National Laboratory
Wright, James R.	United States Air Force Academy